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EDITORIAL

THE PADDY COMMISSION AND THE PRICE OF RICE

THE Paddy Commission appointed by Government has commenced its labours and divided itself up into three Committees to study the subject deputed to it under the terms of reference. These Committees concern themselves with (1) irrigation, drainage and communications, (2) tenancy, credit and marketing, and (3) the possibilities of influencing the situation through rural education and uplift.

There are some who are asking at this stage why with foreign rice so cheap there is need at all to consider paddy production in Ceylon. This is a very specious argument. It is poor consolation to the man who has not the wherewithal with which to purchase and whose sole stock in trade is human energy.

The continued purchase of a foreign product can only be a feasible economic proposition, even if the price be below that of the local article, so long as the money sent out of the country for it is brought in by the sale of some other commodity.

The past condition of affairs in Ceylon agriculture has only been rendered possible by the fact that, although he might not have realised it, the Government official, the office clerk, the banker, the merchant, the baker, the candle-stick-maker earned their wherewithal in the majority of cases, directly or indirectly, from one of the main plantation industries tea, rubber or coconuts. When as at present serious calamity is overtaking these important industries and the worker must of necessity find his labour in less request, never matter what may be the price of foreign rice, it is a policy of the soundest nature to produce and consume to the utmost extent home-grown food grains.

A nation's ability to win in the race for progress depends entirely upon the amount of struggle that it can put up for existence. The need to see how this struggle can be helped and encouraged to continue is now greater than ever in spite of the low prices for foreign rice. These are the duties of the Paddy Commission and such duties are as imperative now as they ever have been if indeed not more so.

PADDY NOTES (IV)

(A) AN IRRIGATION POT EXPERIMENT
(B) THE VIABILITY OF LONG-AGED PADDIES

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(A) AN IRRIGATION POT EXPERIMENT

IT has been found in California that continual submergence of rice fields from an early stage in the growth of the plants has a very definite effect in preventing weed growth. This was confirmed at Peradeniya. It appears that if the fields are submerged before the weeds (mainly *Cyperaceae* with *Fimbristylis miliacea* are probably the most important) are tall enough to reach the water level growth is prevented and the plants eventually die. It has been noticed also that the weed growth in fields unavoidably kept dry in the early stages has been profuse. Where it can be practised, therefore, continual submergence of rice fields offers a method of reducing weeding costs or alternatively of securing a better yield without weeding. Continual submergence, however, can only be carried out where water is plentiful and bunds are sufficiently high and impervious. Moreover, it has been stated that the drying of fields, which perforce takes place in many districts in Ceylon during the growth of the crop sometimes to such an extent that cracks appear in the soil, encourages root development and is therefore beneficial. With the object of obtaining information on this point pot experiments were laid down at Peradeniya in the *yala* season of 1929 and the *maha* season of 1929-30.

The experiments were carried out in cement pots whose inside measurements were 12 in. square and 14 in. deep. Regulated drainage was provided at the bottom of the pots. Precise irrigation experiments under field conditions necessitate the construction of special and expensive bunded fields and drainage channels. As these could not be prepared pots had to be used although it was realised that pots do not exactly simulate field conditions. There can be no doubt, however, that the drying of the pots can be adequately performed, and excessive drying was prevented by confining the dry periods to seven days.

The pots were situated in a plant cage to prevent damage by birds. The depth of soil in the pots was 10 in., and the normal depth of submergence (when the seedlings were tall enough) was 3-4 in. In both seasons four groups (hills) of three seedlings each were transplanted from field nurseries into each pot and the normal drainage and slight irrigation of the pots were followed until ten days after transplanting when the pots were submerged; i.e., from 3-4 in. of water were maintained in the pots; this, of course, did not cover the young seedlings. The pots dried periodically were kept submerged for fourteen days and dry for seven. A small opening was permanently kept in the bottom of all pots to simulate natural drainage. All pots were drained about a fortnight before harvesting.

For the *yala* experiment eighteen pots were used, nine of which were continually submerged. The two lots of pots were placed in two adjoining lines but there was no randomization of the pots. The mean yield of the periodically dried pots was 54·26 and of the submerged pots 59·36. The standard error of the mean difference was 2·85 (5·02%). The difference in yield is not statistically significant. A more precise experiment followed for *maha* in which twenty-four pots were used, in randomized groups of three giving eight replications. To the previous two treatments of periodic drying and continual submergence throughout the growth of the crop there was added a third treatment, that of periodic drying for the first three months followed by continual submergence thereafter. The results of the experiment will be found in table I and the analyses of variance in tables II and III.

TABLE I

Synopsis of the Irrigation Pot Experiment, Maha 1929-30

Treatment	Total yield of 8 pots in gm.		Mean yield per pot in gm.		Yield expressed as percentages of treatment B.	
	grain	straw	grain	straw	grain	straw
A. Periodic drying ...	504·5	631·0	63·06	78·87	76·27	74·24
B. Continual submergence ...	661·5	850·0	82·69	106·25	100·00	100·00
C. Combination of A. & B. ..	533·5	690·5	66·69	86·31	80·65	81·24

TABLE II

Analysis of variance, grain weights.

Variance due to	Deg. of F.	Sum of squares	Mean squares	S. D.	Log E.	SEmd.
Blocks ...	7	772·822				
Treatments ...	2	1748·999	874·4995	29·57	3·3868	
Exptl. Error ...	14	1292·834	92·3453	9·61	2·2628	4·93 (6·96%)
Total ...	23	3814·655		$Z =$	1·1240	5% point Z = ·6594

TABLE III

Analysis of variance, straw weights.

Variance due to	Deg. of F.	Sum of squares	Mean squares	S. D.	Log E.	SEmd.
Blocks ...	7	1404·096				
Treatments ...	2	3204·086	1602·043	40·03	3·6896	
Exptl. Error ...	14	1154·748	82·482	9·08	2·2061	4·54 (5·02%)
Total ...	23	5762·930		$Z =$	1·4835	5% point Z = ·6594

It will be seen that the continually submerged pots have beaten both the other treatments and the experiment with both grain and straw yields successfully passes the Z test. The close agreement between grain and straw differences is striking.

It may be definitely concluded that under normal conditions of drainage periodic drying has no advantage which is reflected in grain or straw yields and that on the other hand there is evidence to show continual submergence is beneficial.

(B) THE VIABILITY OF LONG-AGED PADDIES

One of the writers has already published* certain data about the germination of rice seeds in Ceylon, chiefly concerning the length of the resting period which ensues after harvesting before maximum germination is attained. The following account of the effect of age on viability is the natural continuation of the study there begun and shows the rapid fall in the germination percentage which takes place after seed has been left in storage for a year.

* Lord, L. The germination of rice seeds in Ceylon.—*Annals Roy. Bot. Gardens, Peradeniya*, XI, 2-123, 1929.

In this investigation the seed, nine different pedigree selections, was tested for viability at 7, 10, 13, 16, and 19 months after harvest. The seed was stored in a fumigated seed store at Peradeniya and the selections included both large and small grained rices. The age of the selections (that is the time from sowing to ripening) varied from 6-6½ months. In each test 400 seeds of each selection were taken and the test was carried out according to the technique described in the publication mentioned above.

The results of the tests will be seen graphically in Fig. I. From ten months after harvest the viability of the seed lessens and there is a heavy fall between the thirteenth and sixteenth month. By the nineteenth month none of the selections was viable. Normally the seed of long-aged paddies is sown 5½ to 6 months after harvest. Should unfavourable conditions prevent the crop being sown the seed will be useless for sowing the following year, that is eighteen months after harvest. Fortunately the complete loss of a crop in the regions when such long-aged paddies are grown is rare but where short-aged paddies (3-4 months) are grown crops are sometimes a complete failure or in bad seasons cultivation may not take place. In these cases the question of seed becomes urgent and is generally obtained from places where a crop was grown the previous year. The effect of age on the viability of short-aged paddies is under investigation.

(C) A NOTE ON THE EFFECT OF SOWING DATE ON THE AGE OF MAHA PADDY

L. LORD, AND J. S. T. DE SILVA.

THE correct sowing date for a variety of irrigated paddy is determined by (a) the date or period when the crop should ripen and (b) the age of the variety. There are very definite periods for most parts of Ceylon during which the crop must mature if satisfactory yields are to be obtained. Such periods may last for a month but are nevertheless comparatively restricted and are determined largely by weather conditions and to some extent by the incidence of paddy-fly attack. The weather at sowing time may influence the sowing date in that if sufficient water is not available at the proper time to enable the normal-aged variety to be grown a shorter-aged paddy must be sown later. Long-aged paddies (6-6½ months) seem to respond more markedly to change of sowing

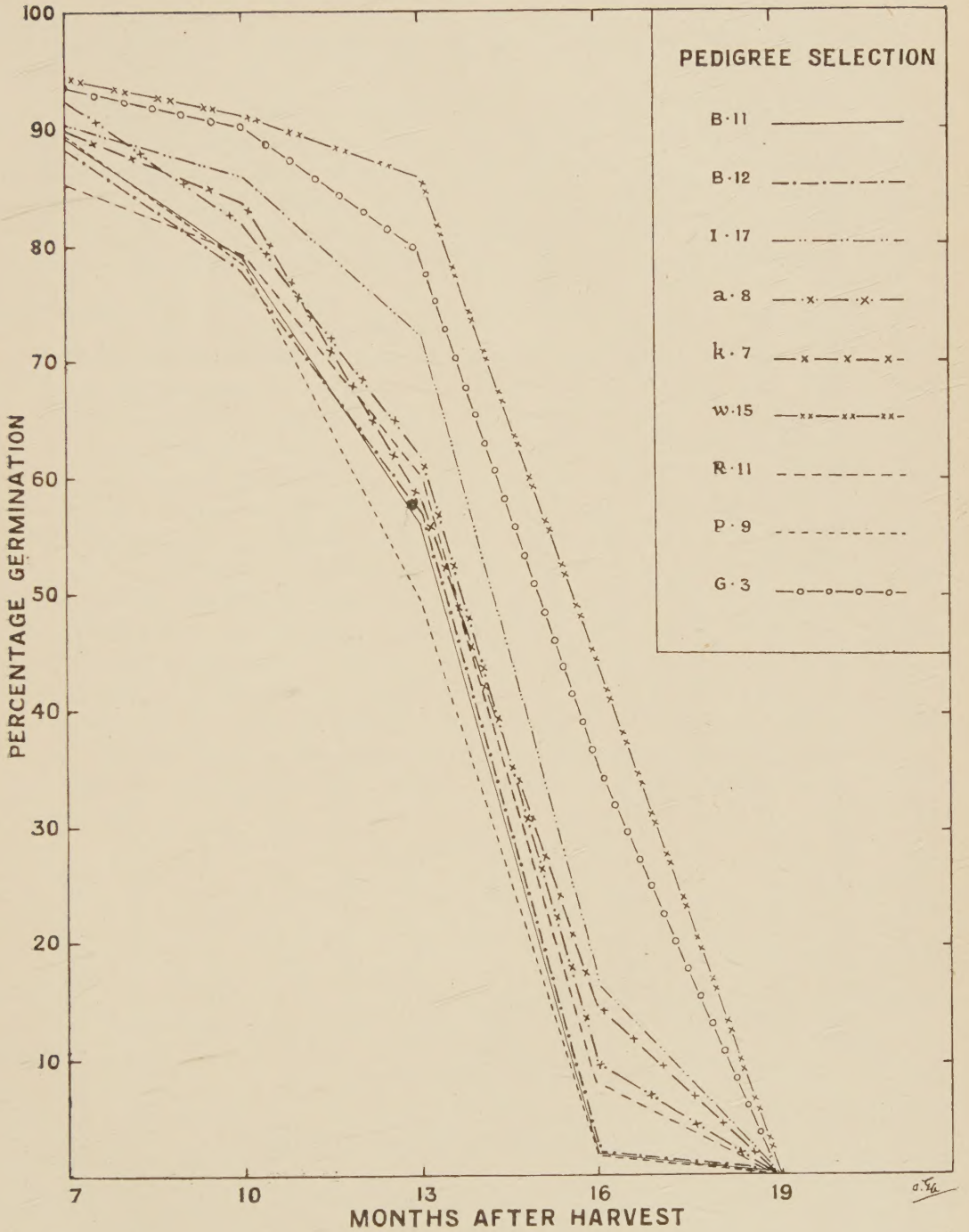

Fig. I.

The viability of long-aged paddy seed.

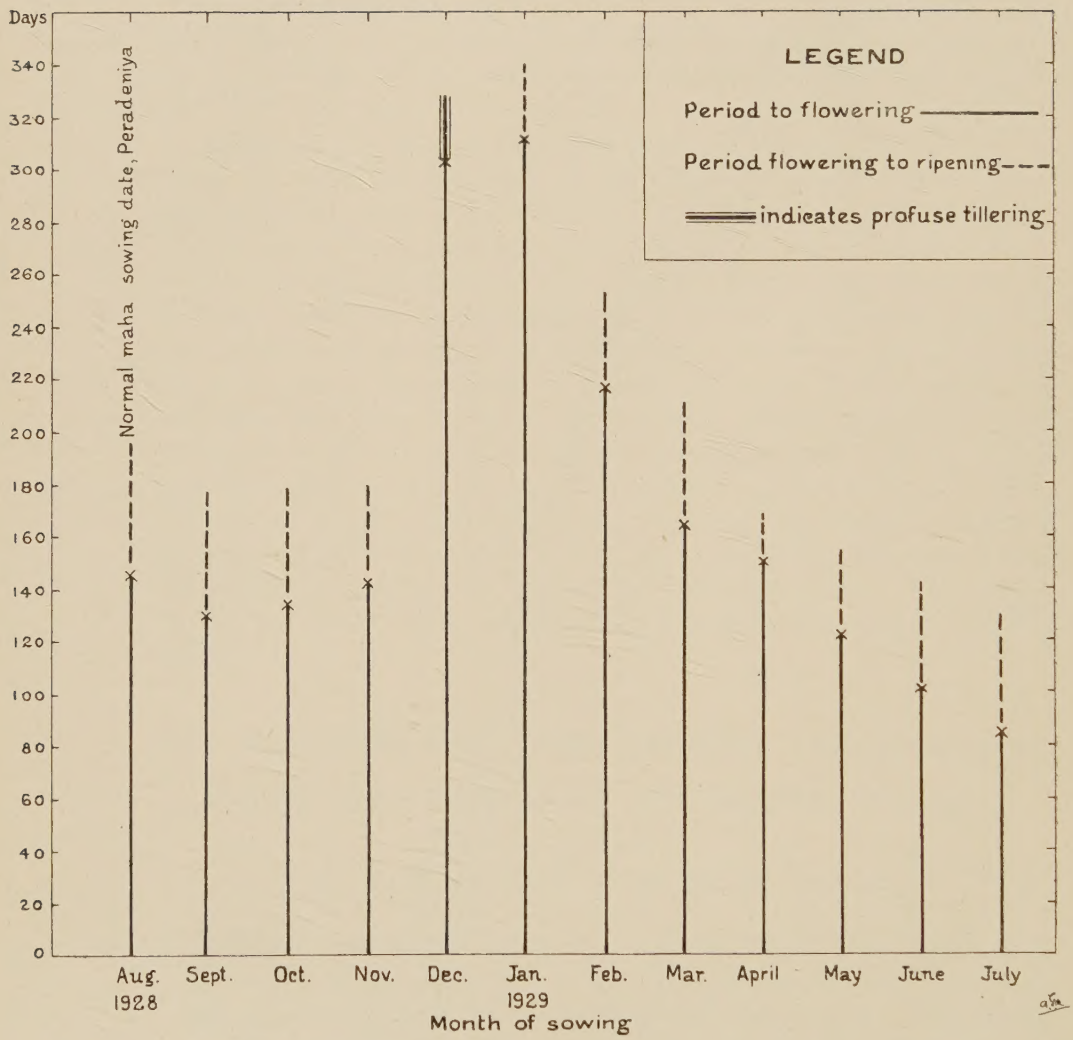

Fig. II.

The effect of sowing date on age of a maha paddy.

date than short-aged paddies and instances had been reported where long-aged paddies sown at the wrong time had never flowered.

The opportunity was taken at Peradeniya in 1928 and 1929 of sowing a *mawi* selection whose normal age was 6-6½ months, monthly throughout a complete year with the object of noting the changes in the growth period. These are shown graphically in Fig. II. The first sowing took place in August (the normal month for sowing at Peradeniya) and the last in the following July.

The normal age was 195 days and the September, October, and November sowing showed but little departure from this but from October onwards the panicles were not fully developed and yields in the field would have been unremunerative. The plants sown in December were caught by the north-east monsoon when normally they should have been flowering. No flowering took place at all and growth continued for 328 days. During the last 25 days profuse tillering took place. The January sown plants grew for 339 days and at maturity the few panicles formed were composed almost entirely of empty grains. From February onwards the age decreased until from May onwards it was very definitely sub-normal. In all these cases few panicles developed and all contained numerous empty grains. The effect of sowing at the wrong time will probably vary with different climates.

It will be seen that the meticulous care taken by the cultivator to sow the proper aged variety is sound agricultural practice.

CHEMICAL NOTES (10)

FURTHER ANALYSES OF LEGUMINOUS GREEN MANURES

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IN 1926, analyses of a number of green manure plants were made in the Chemical Division and the results published in *The Tropical Agriculturist* for October of that year. Since then several leguminous green manures have been introduced into Ceylon and it was thought desirable to analyse some of these, as well as a few of the more-important older species that had not been examined. With a view to obtain results which would be comparable, all samples were taken at the flowering stage only, and their leafy material and tender stems analysed. As previously pointed out it is obvious that the analytical figures obained cannot be regarded as representing the composition of all samples of the same species. It is, however, hoped that they would give a fair idea of the manurial values of these green manures.

The results of the analyses are calculated on the fresh material and on dry matter at 100°C. The sample of *Parochetus communis* was obtained from Lippakelle Estate, Talawakelle, the two samples of *Psoralea corylifolia* and *Rhynchosis nummularia* from the Northern Division, and the others from the Experiment Station, Peradeniya.

The results are set out in the table. An examination of it would show that the nitrogen as well as the ash contents in the fresh material of the various green manures vary a great deal. Of all the plants analysed *Derris robusta* appears to be the best as it contains the highest amounts of nitrogen, ash, lime, and potash. Its phosphoric acid content is also high. Lowest figures for all constituents in the fresh material are obtained in the case of *Parochetus communis* and this is evidently due to its low dry matter content which is only 14·3%, as compared with dry matter contents of 38% and 33·4% in *Derris robusta* and *Albizzia chinensis* respectively. The results on dry matter at 100°C show however that this plant has the highest amount of phosphoric acid and that its potash content too is comparatively

high. Thus it will be noted that a better idea of the relative value of the various green manures could be obtained by examining the results on material at 100°C.

The table shows that the figures for the various constituents obtained from these analyses are about the same as those obtained previously with the one exception of *Psoralea corylifolia* which has an ash content as high as 11·5% consisting chiefly of lime and potash. The percentages of nitrogen for the various species do not vary to any great extent. The nitrogen content is 3·47% obtained in the case of *Albizzia chinensis* as against a minimum of 2·48% in *Psoralea*. As already pointed out the highest amounts of lime and potash are found in *Psoralea*. The smallest percentage of lime is found in *Crotalaria brownei* and of potash in *Albizzia chinensis*. The latter has also a low percentage of lime. The phosphoric acid content is highest in *Parochetus* and again lowest in *Albizzia chinensis*. There does not appear to be any relation between the nature of the species analysed and their composition.

Analyses of Green Manures

No.	Variety	Nature of plant	On fresh material Per cent							On dry matter at 100°C Per cent					
			Moisture	Organic matter	Ash	Nitrogen	Lime	Potash	Phos. acid	Organic matter	Ash	Nitrogen	Lime	Potash	Phos. acid
1	Derris robusta	Tree	62·0	35·1	2·91	1·19	·74	·73	·19	92·3	7·68	3·14	1·98	1·93	·51
2	Albizzia procera	,,	73·5	24·1	2·43	0·69	·55	·68	·21	90·8	9·17	2·62	2·09	2·58	·81
3	Albizzia chinensis	,,	66·6	34·4	1·97	1·15	·46	·42	·15	94·1	5·92	3·47	1·37	1·24	·44
4	Crotalaria brownei	Bush	76·1	22·2	1·68	0·71	·29	·56	·16	92·9	7·06	2·93	1·24	2·36	·48
5	Psoralea corylifolia	,,	–	–	–	–	–	–	–	88·5	11·53	2·48	5·26	4·14	·55
6	Tephrosia tinctoria	,,	72·8	25·5	1·74	0·94	·47	·51	·14	93·6	6·41	3·45	1·75	1·88	·51
7	Desmodium heterocarpum	Bushy creeper	66·5	32·4	1·15	1·03	·46	·59	·16	94·2	5·81	3·07	1·38	1·76	·49
8	Parochetus communis	Creeper	85·3	13·4	1·34	0·42	·23	·37	·13	90·8	9·15	2·82	1·54	2·51	·87
9	Pycnospora hedysaroides	,,	66·7	30·8	2·48	1·07	·58	·67	·21	92·5	7·45	3·24	1·74	2·02	·63
10	Rhyncosis nummularia	,,	–	–	–	–	–	–	–	91·4	8·58	3·37	3·17	2·52	·69

SPRAYING AGAINST CANKER OF CITRUS

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SPRAYING experiments were begun on citrus trees (grapefruit) at the Experiment Station, Peradeniya, on 8 December, 1930. The trees were three to three-and-a-half years old and averaged about ten feet in height. Fifteen trees were selected for the experiment; of these, five were sprayed with a $\frac{1}{2}$ per cent aqueous solution of concentrated lime-sulphur weekly, five with 1 per cent fortnightly while five served as controls. Before the experiment was started each tree was examined primarily to ascertain the severity of citrus canker on the leaves and branches.

Citrus Canker is one of the commonest diseases of citrus plants in Ceylon and is caused by the bacterium *Pseudomonas citri*. The disease is widespread in its distribution and is found in the United States of America (in Florida and some of the Southern States), in Japan, China, Java, India, Malaya, and Ceylon. In Ceylon it is more common at lower elevations, particularly in the wetter zones.

The first symptom of the disease is the appearance of yellow spots on the leaves. Later, small brown coloured, corky, eruptive growths are produced from these yellow spots. The character which distinguishes them from other eruptions of a similar nature is the yellowing of the leaf tissue round the eruption which gives the appearance of a sort of halo. The canker occurs on leaves, fruits, green twigs and young stems and in older stages may completely girdle twigs and young stems to cause the dying back of the parts above.

The presence of fungi and pests on these trees was also noted. Dr. J. C. Hutson, the Government Entomologist, identified the following pests: Fluted scale (*Icerya purchasi*), mussel-shell scale (*Lepidosaphes citricola*) and green bug (*Coccus viridis*) were found on the stems, while *Icerya seychellarum*, *Lepidosaphes gloveri*, *Lepidosaphes gloveri* var *pallida*, probably at least two species of *Chionaspis*, *Lecanium* sp., leaf miner (*Phyllocnistis citrella*) black fly (*Aleurocanthus* sp.) and aphids (*Toxoptera aurantii*) were present on the leaves.

Among the fungi recorded were *Septobasidium* sp. and sooty mould which develop on the secretions of scale insects, *Cephalosporium lecanii*, parasitic on green bug (*Coccus viridis*), *Microcera* sp. parasitic on *Lepidosaphes citriola* and *Chionaspis* sp.

The primary object of the experiment was to ascertain the efficacy of the spray fluid against the spread of the bacterium which caused citrus canker on leaves, branches, and fruits; it also afforded an indication of the effect of the spray on fungi and insects commonly present on citrus.

Fungi like sooty mould and *Septobasidium* sp. which live on the secretions of the scale insects are not very harmful when they are present in small quantity, but when they occur in abundance they may seriously retard growth and render the tree less resistant to drought. The dense, black structure which the sooty mould fungus forms on the leaves reduces the amount of light reaching the chlorophyll and consequently diminishes the activity of the latter in manufacturing food.

Pests like fluted scale, green bug, and aphids reduce the vitality of the tree by sucking its plant juice. All these factors working together may have a detrimental effect on the health of the trees and their subsequent production of fruit.

No attempt was made to cut off affected twigs and leaves as it is realized that this procedure would be impracticable especially in the case of large trees where in severe attacks a large percentage of the leaves are affected.

As stated above five trees were sprayed weekly with a $\frac{1}{2}$ per cent aqueous solution of concentrated lime-sulphur, and five trees fortnightly with a 1 per cent solution. After the former group had received ten applications and the latter five, the trees were individually examined. It was observed that the spray did not arrest the spread of the canker to the young shoots to a marked degree, that some of the scale insects were not killed in the trees which were treated with the $\frac{1}{2}$ per cent solution and that the leaf mining caterpillar was still active carrying the bacterium of the canker to young foliage.

On 16 February, 1931 a change was effected in the strength of the spray fluid. The trees that received a $\frac{1}{2}$ per cent solution of the lime-sulphur were treated with a 1 per cent solution and those that received the 1 per cent were sprayed with a 2 per cent solution. After the former group had received eight applications and the latter four of the increased strengths the trees were again individually examined. The effect of the increased strength of the spray fluid was noticeable. Pests such as green bug and scales were completely wiped out together with the fungi such as sooty mould which lived on their secretions; the *Septobasidium* which enveloped the larger branches were seen to have cracked and dropped off; the spread of the canker to the young foliage was arrested to a considerable extent; the leaf mining caterpillar was present but the damage it did was

negligible. From observations made it appeared that the leaf miner infected the leaves in the interval between the application of the spray fluid. The spray did not appear to be completely effective against ants and aphids though their numbers were reduced considerably. No difference was noticeable in the trees sprayed weekly with the 1 per cent solution compared with the trees sprayed fortnightly with the 2 per cent solution.

From the above experiments and observations made in the field it is recommended that (1) trees should be sprayed weekly with a 1 per cent aqueous solution of concentrated lime-sulphur or fortnightly with a 2 per cent solution, (2) affected twigs and leaves should be cut off and burnt wherever possible. The Entomologist suggests that the application of a spray of tobacco wash between the application of lime-sulphur will be effective against aphids and leaf miner.

Canker infection takes place most readily on young leaves. If new foliage growth can be stimulated during the drier periods of the year in which canker infection is not so common, some infection may be avoided. Young trees should therefore be watered during dry weather to stimulate growth and if manuring is undertaken it should be done so that the maximum effect is felt during dry weather.

Wherever possible infected twigs and foliage should be pruned out to remove sources of infection. Spraying against citrus canker is a preventive and not a curative measure. Once the bacterium is inside the tissues of the host plant spraying will not eradicate it but will, to a great extent, prevent it from spreading to neighbouring leaves and branches.

If citrus is planted 15 feet by 15 feet, 195 trees will cover an acre. In the experiments described above, 2 gallons of solution were used for five trees. This quantity was considered the minimum amount of spray fluid required for the trees of the size experimented upon. Based on these calculations roughly 13 pints of concentrated lime-sulphur solution will be required for spraying an acre of citrus with a 2 per cent solution.

If the citrus plants are young, spraying can be carried out with small hand sprayers; if done on a larger scale or if big trees are to be sprayed, the use of a knapsack sprayer will be most convenient.

If the routine spraying recommended above to control citrus canker is adopted, the spray will help to prevent infection by pink disease (*Corticium salmonicolor*) and mildew (*Oidium tingitaninum*) which are responsible for dieback in citrus and when once established on a plantation are troublesome to eradicate.

TEA MANURING UNDER SLUMP CONDITIONS

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THE problem facing those responsible for many tea estates at present is that of finding methods of reducing the cost of production of their tea. The drop in prices has in many cases reduced the margin of profit to a vanishing point and all expenditure must be scrutinised with the utmost care.

An obvious economy is the reduction or elimination of the eight or ten cents per lb. spent on manuring. Reports of the bad effects following on the cessation of manuring in the 1921 slump are however such that many regard the discontinuance of manuring as a policy of extremely doubtful value when a long view is taken.

While this is undoubtedly true, the problem of finding immediate economies is so pressing that some discussion of the problem as it affects manuring expenditure may be welcome.

The simplest method of economy is to apply the mixtures already in use at a reduced rate per acre but it can possibly be improved upon.

It must be remembered that the fate of the various plant foods which have been added to the soil in the past has varied considerably. Practically the whole of the Phosphoric Acid which has not been actually removed in the tea leaf will be found in the soil, the frames of the bushes, or in the green manure crop.

The bulk of the Potash will be found in the same way, though a larger amount will probably have been lost by drainage.

On the other hand the accumulation of reserve stores of Nitrogen is difficult and the effect of past applications can be very largely discounted. The process of building reserve stocks of Nitrogen even when slow acting organic manures are used and green crops are grown is very slow. The estate which has by these means built up the fertility of its soil to a really high degree is extremely fortunate at the present time. It must be remembered however that nothing is easier to lose than this fertility under Ceylon conditions where all the factors which make for Nitrogen losses are at their maximum.

The reduction in manuring expenditure should then, from theoretical considerations, fall rather more heavily on the Phosphates and Potash of the manure mixture than on the Nitrogen. The actual cuts which can be made in this expenditure will depend on the past manuring history of the estate as manuring

programmes vary widely in the proportions of plant food they supply. Reduction of the amount of Nitrogen used in mixtures is a more difficult problem but the fact that this ingredient is very much the most expensive used makes it essential to reduce the money spent on this item if at all possible.

One method of reducing the cost of this is to substitute cheap inorganic Nitrogen for more expensive organic forms, but it must be remembered that inorganic Nitrogen while it gives a rise in crop over a short period tends to lower the quality of the tea produced. Any increase in the amount of this form of Nitrogen at the present time is therefore so much against the general interests of the industry that it cannot be entertained even though the immediate results may be superficially attractive to individual estates. From both the estate and the general point of view the ideal must be to produce a crop of the best possible quality at a lower cost per lb. and these objectives must be attained without any damage to the high state of general agricultural health of the properties.

The only means of attaining this end is the use of good quality organic material as the source of the greater part of the Nitrogen.

The reduction that must be made in the total Nitrogen to be applied should then take effect to a greater degree on the inorganic Nitrogen while the organic Nitrogen is cut to a much smaller extent if at all.

There is no ground for selecting any particular form of Phosphoric Acid or Potash to be reduced in preference to any other and cuts can be made on the total amount without reference to the forms used. The amount of the cut should of course depend on the amounts previously used for the reasons set out above.

Such a programme should obviate the bad effects of a reduction in the amount spent on manure. The loss of crop is reduced to a minimum while quality is retained or even improved. No drastic alteration is made in the food supply to the bush and the evenness of action obtained from a largely organic mixture will maintain the general fertility and health of the estate as a whole.

The part played by inorganic Nitrogen in the production of the present surplus of tea is considerable and the quantity of tea attributable to this source in a normal year is estimated at 56,000,000 lb. While it is not suggested that the whole of this inorganic Nitrogen should be dispensed with a considerable reduction is possible and this combined with a smaller reduction in organic Nitrogen would restrict production to a considerable extent with a correspondingly good effect on the market.

CONTRIBUTIONS FROM THE RUBBER RESEARCH SCHEME, CEYLON

THE CAUSE OF VARIABILITY IN THE PLASTICITY OF PLANTATION RUBBER AFTER STORAGE

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THERE are two reasons why a study of the plasticity of rubber is of importance to the planter, viz: (1) the variable plasticity of plantation rubber leads to many difficulties in manufacturing operations; and (2) first-grade plantation rubber is so hard that it is frequently mixed with inferior grades and other materials to enable it to pass more easily through the different processes.

The results of the investigations recorded in this report suggest a definite reason for the hardness and variability of first-grade rubber.

Tests carried out by De Vries in Java showed (1) the freshly prepared plantation rubber is uniform in plasticity but that many samples gradually become hard or soft on keeping and so develop differences; and (2) that rubber containing more serum substances than usual becomes hard and that containing less than usual becomes soft (Trans. I. R. I., **3**, 1927-28, p. 284). On the other hand tests carried out by the Scheme on a large number of samples of over three years show that in most cases rubber becomes harder on keeping for six months at 15°C. The hardening of the rubber at European temperatures has been confirmed by Griffiths of the Dunlop Rubber Co., Ltd., who stated that large-scale experiments on rubber from different estates showed that in all cases, after storage for three years, it was necessary to increase the time of milling by about 30 per cent in order to obtain the required plasticity (Trans. I. R. I., **3**, 1927-28, p. 300).

As raw rubber is subjected to a wide range of temperatures and humidity conditions before use by the manufacturer a detailed investigation is being carried out at the Imperial Institute on the effect of different conditions of storage.

The results of preliminary tests (Second *Quarterly Circular* of the Rubber Research Scheme, Ceylon, 1930) showed that (1) rubber becomes slightly harder at 15°C than at 0°C; and (2) rubber hardens more quickly in a dry than in a damp atmosphere.

Further experiments have now been made with crepe and sheet stored for six months at 0°C, 15°C, 30°C, and 45°C. As it was desirable to ascertain whether the changes in plasticity were due to changes in the rubber independent of external factors such as oxygen, some of the samples were kept in sealed glass tubes containing dry nitrogen and others in tubes containing dry oxygen. If oxygen is responsible for changes in the plasticity of rubber on storage, it might be anticipated that the changes would be accelerated by the removal of anti-oxidants from the rubber. Accordingly a portion of the sheet was treated with dilute ammonia solution for three weeks to remove anti-oxidants; another portion was treated with water for comparison; and a third with tannic acid solution, the tannic acid being regarded as a possible anti-oxidant. The results of the usual hardness tests at 100°C are shown in the following table and diagrammatically in Fig. 1.

Sample	* D_{30} (mm./100) before storage	* D_{30} (mm./100) after storage for six months in							
		Dry nitrogen at				Dry oxygen at			
		0°C	15°C	30°C	45°C	0°C	15°C	30°C	45°C
Crepe (No. 1452)	170	178	205	213	222	156	173	185	164
Smoked sheet (No. 1455)	191	186	203	208	215	173	183	182	182
Smoked sheet extracted with cold water	189	—	209	—	—	175	188	—	142
Smoked sheet extracted with ammonia	189	—	213	—	—	166	186	—	111
Smoked sheet soaked in tannic acid	189	—	217	—	—	170	191	—	162

* D_{30} = Thickness (in hundredths of a millimetre) of sphere 0·4 grams in weight after pressing under a load of 5 kgs. at 100°C for 30 minutes.

The results show that the changes in hardness which occur when rubber is stored in dry oxygen are different from those which occur on storage under the same conditions in nitrogen. In nitrogen the rubber becomes hard and the hardness increases with the temperature. In oxygen the rubber is always softer than in nitrogen at the same temperature and the difference increases with the temperature.

These results suggest that two fundamental factors are responsible for the changes which occur in the plasticity of rubber on storage: (1) a spontaneous hardening which occurs in nitrogen and therefore probably in any inert atmosphere; and (2) a softening induced by oxygen. These changes occur simultaneously when oxygen is present, but an increase in temperature accelerates the rate of softening more than the rate of hardening. At low temperatures hardening exceeds softening and at high temperatures softening exceeds hardening and, as will be seen from the diagram, the critical temperature is about 30°C but depends upon accessory substances in the rubber.

The ammonia-extracted rubber became extremely soft in oxygen at 45°C, although it hardened at 15°C, whilst the same rubber not treated with ammonia had a tendency to harden even at 45°C. Previous experiments with ammonia-extracted rubber have indicated that it possesses poor ageing properties when vulcanised, and it is assumed that this is due to the removal of anti-oxidants. (Trans. I. R. I., 1926-7, **2**, p. 368). The removal of these constituents therefore appears to affect not only the ageing properties of the vulcanised material but also those of the raw material.

The water-extracted rubber also softened in oxygen at 45°C but not as much as the ammonia-extracted rubber; this also agrees with the results of the ageing tests on the vulcanised material referred to above. Tannic acid does not appear to have a marked anti-oxidant effect.

These results explain the differences previously observed between the effect of storage in the tropics and in Europe. At European temperatures spontaneous hardening nearly always exceeds softening due to oxygen, even when the amount of anti-oxidants present is much less than usual. At tropical temperatures rubber becomes hard or soft according to the amount of serum substances present. These contain natural anti-oxidants, with the result that even at tropical temperatures rubber containing more serum than usual becomes hard.

Although this work is only in its initial stage the results indicate methods by which it may be possible to control the plasticity of rubber on estates.

HARDNESS (D30) of raw rubber after exposure for six months in dry OXYGEN or NITROGEN at different temperatures.

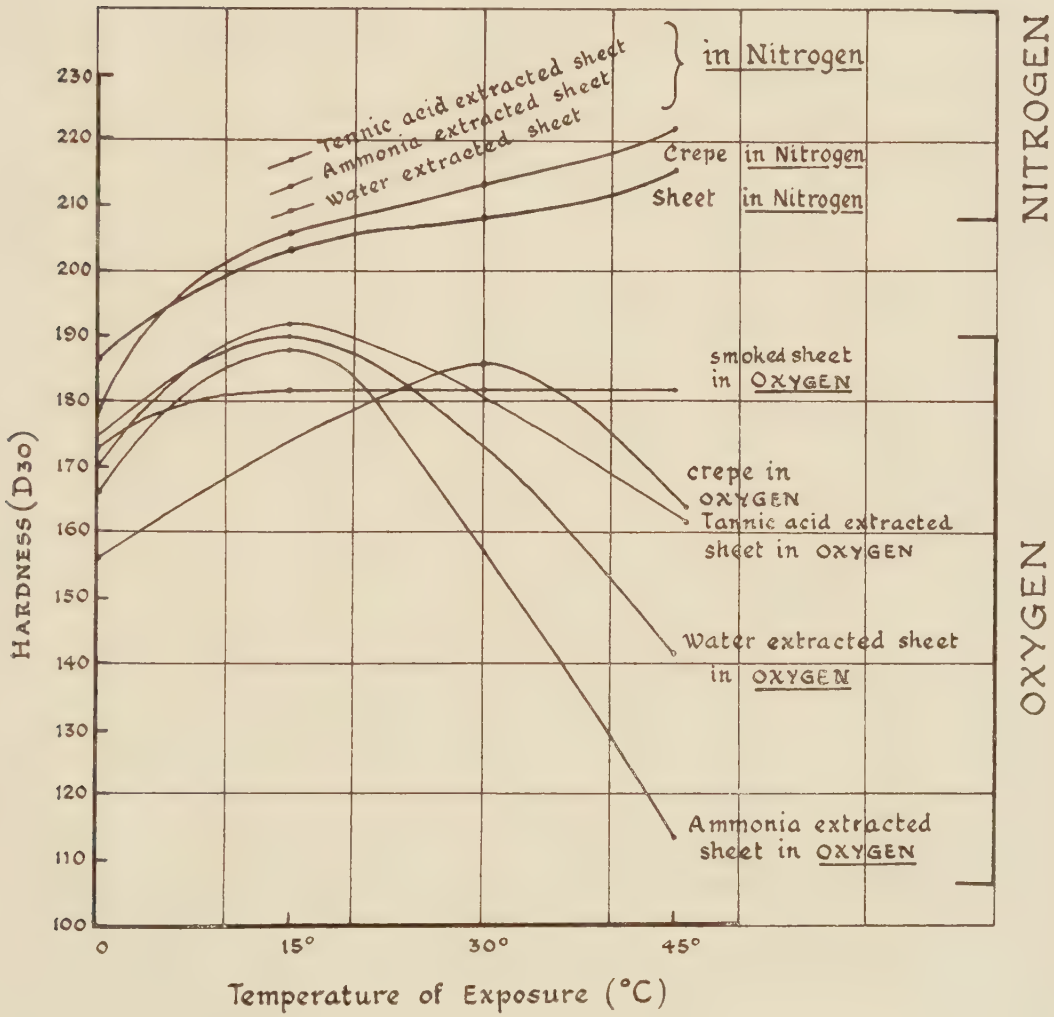

Fig. I.

THE EFFECT OF MATURATION ON THE PLASTICITY OF SMOKED SHEET

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IT is the practice in Java when preparing smoked sheet rubber to remove the coagulum from the serum on the same day as the acid is added, but in Malaya and Ceylon it is more useful to remove the coagulum on the day following. During the period the coagulum remains in the serum, changes occur in the non-rubber accessory substances which affect the rate of vulcanisation of the rubber. It is to be expected therefore that these changes occur to a greater extent in Ceylon and Malaya than in Java, and that the different practices lead to some variability in the properties of rubber.

Although the effect of keeping the coagulum in the serum has been studied thoroughly as regards rate of vulcanisation little is known as to whether the changes which occur affect the plasticity of rubber. This also is an important property affecting the utilisation of rubber.

Two sets of experiments were described in Bulletin 49, p. 2, showing that crepe from coagulum kept in the serum for two days was harder than crepe from coagulum removed after a few hours.

Two further sets of experiments have now been carried out in which the coagulum after keeping for different periods in the serum was rolled to sheet and smoked. The results obtainted are not in agreement with those given by crepe, the period the coagulum remained in the serum apparently having no effect on the plasticity of sheet. Mr. O'Brien (who prepared the samples) has suggested that the difference in the results given by crepe and sheet is due to the addition of sodium bisulphite to the latex when preparing crepe. This is a probable explanation because it has already been shown that sodium bisulphite has a hardening effect on rubber, and it is possible that the longer the coagulum remains in the serum the greater is the effect of the bisulphite.

More information concerning the different results given by crepe and sheet could be obtained by determining the plasticity of crepe prepared from latex containing no bisulphite and matured for different periods, and it is hoped to carry out this experiment when opportunity occurs.

The two sets of sheet samples were prepared at an interval of 18 months. A description of the first set and the results obtained are given in the Rubber Research Scheme *Quarterly Circular*, Vol. 6, Part 2, 1929, p. 1. The samples in each set were prepared from latex divided into two portions, one being coagulated with acetic acid and the other with a mixture of acetic acid and paranitrophenol. The latter is a disinfectant used chiefly for the prevention of mould. It was employed in these experiments to determine whether it retarded changes in the accessory substances during the period the coagulum was kept in the serum. In the second set a portion of the sheet from the coagulum which had been allowed to remain in the serum for the longest period was rolled up wet and kept in this condition for five days before drying in smoke. At the end of this period the sheets without paranitrophenol had a putrid odour but the others were still fresh.

Plasticity Tests.—The results of plasticity tests are shown in table I. They include a hardness test soon after the arrival of the samples in London and after keeping for six months, and in addition a mastication test on the stored samples.

The results show that keeping the coagulum in the serum had no definite effect on the hardness of the sheet samples on arrival in London or after storage for six months under different conditions (for detailed particulars of conditions of storage of the first set and the results obtained see *Quarterly Circular*, Vol. 6, 1929, Part 2, p. 2 and, Vol. 7, 1930, Part 2, p. 23). It is of interest however that the sample rolled up wet and free from paranitrophenol in the second set was harder than the others on arrival and required more mastication than the others after keeping at 60°F for six months. It is possible therefore that maturing the coagulum may cause a small decrease in plasticity, but this is not obvious from tests in which the coagulum is allowed to remain in the serum and then rolled and dried, because the biological changes may be accompanied by an alteration in the distribution of the non-rubber substances between the coagulum and the serum.

Paranitrophenol had no definite effect on the hardness of the samples except when these were stored in a damp atmosphere when the samples without paranitrophenol became mouldy and hard.

Vulcanisation Tests.—Most of the samples were submitted to tests to determine the extent to which the changes occurring during the maturing of the coagulum affected the rate of vulcanisation, and the influence of paranitrophenol on these changes. The results obtained are shown in table II. In the first set of experiments only small changes occurred in the rate of vulcanisation of the samples in consequence of keeping the coagulum in the serum and these changes were unaffected by paranitrophenol. In the second set of experiments the alterations were more marked. Keeping the coagulum in the serum for 44 hours as compared with 4 hours reduced the time of vulcanisation by 15 per cent in the absence of paranitrophenol and by 8 per cent in the presence of paranitrophenol. When the coagulum kept in the serum for 44 hours was rolled up wet, the time of vulcanisation was reduced by a further 10 per cent in the absence of paranitrophenol and by 5 per cent in its presence.

In the first set of experiments paranitrophenol had little effect on the changes which occurred when coagulum was allowed to mature but in the second set it definitely retarded these changes. As the changes which occur during maturing may be partly due to accidental infection it is not surprising that different experiments do not always agree. It is evident that paranitrophenol may reduce variability due to differences arising during maturation of the coagulum but insufficient evidence has yet been obtained as to its general effect in this direction.

Table I

Set 1

Sample No.	Coagulant	Interval between addition of coagulant and rolling	On arrival in London	After storage for six months at 60°F	
			D_{30}	D_{30}	Mastication
		hrs.	mms./100	mms./100	No.
1,385	Acetic acid	4½	154	161	94
6	,, ,,	17¾	158	158	95
7	,, ,,	35½	156	165	95
8	,, ,,	40¼	156	161	120
9	,, ,,	55½	159	167	109
90	Acetic acid and paranitrophenol	4½	151	156	104
1		17¾	158	151	109
2	,, ,,	35½	155	158	108
3	,, ,,	40¼	156	163	105
4	,, ,,	55½	155	167	107

Set 2

Sample No.	Coagulant	Interval between addition of coagulant and rolling	On arrival in London	After storage for six months at 32°F		60°F	
			D_{30}	D_{30}	Mastication	D_{30}	Mastication
			mms./100	mms./100	No.	mms./100	No.
1,500	Acetic acid	4	159	153	92	157	98
1,501	,, ,,	18	159	150	94	159	107
1,502	,, ,,	23	164	154	93	161	107
1,503	,, ,,	28	159	158	101	157	96
1,504	,, ,,	44	160	161	97	153	98
1,505	Acetic acid and paranitrophenol	4	152	152	93	158	92
1,506		18	158	155	94	160	101
1,507	,, ,,	23	156	151	93	159	96
1,508	,, ,,	28	161	156	101	168	98
1,509	,, ,,	44	159	149	92	165	100
1,510	Acetic acid (sheeted coagulum rolled up wet)	44	169	156	96	170	110
1,511	Acetic acid and paranitrophenol (sheeted coagulum rolled up wet)	44	164	152	95	159	102
1,512	Estate sample	—	154	157	94	159	96

Table II

Set 1 Mixing 90 rubber, 10 sulphur

Sample No.	Coagulant	Interval between addition of coagulant and rolling	Time of vulcanisation	Tensile Strength	Elongation at load of 1·04 kgs./sq. mm.	Calculated time of vulcanisation at 148°C (E 1·04 = 775)
			mins.	lb./sq. in.	per cent	
1,385	Acetic acid	4½	120	1,580	853	120
6	,, ,,	17¾	,,	1,670	848	118
7	,, ,,	35½	,,	1,830	832	114
8	,, ,,	40¼	,,	1,840	840	116
9	,, ,,	55½	,,	1,850	820	111
90	Acetic acid and paranitrophenol	4½	,,	1,460	860	121
1	,, ,,	17¾	,,	1,950	840	116
2	,, ,,	35½	,,	1,560	847	118
3	,, ,,	40¼	,,	1,830	824	112
4	,, ,,	55½	,,	1,950	824	112

Set 2 Mixing 100 rubber, 10 sulphur

Sample No.	Coagulant	Interval between addition of coagulant and rolling	Time of vulcanisation	Tensile Strength	Elongation at load of 1·00 kgs./sq. mm.	Calcutated time of vulcanisation at 148°C (E1·00 = 800)
			mins.	lb./sq. in.	per cent	
1,500	Acetic acid	4	120 140	1,970 1,990	846 777	134
1,504	,, ,,	14	100 120	1,710 2,050	852 780	114
1,505	Acetic acid and paranitrophenol	4	120 140	1,960 2,120	840 776	133
1,509	,, ,,	44	120	2,100	807	122
1,510	Acetic acid (sheeted coagulum rolled up wet)		100	2,230	807	102
1,510	Acetic acid and paranitrophenol (sheeted coagulum rolled up wet)	44	120	2,320	784	116

RESEARCH WORK ON RUBBER CULTIVATION IN 1929 (CONTINUED)*

Yield.—An extensive enquiry was made by Tengwall on the production of 275 estates in Java and South Sumatra with a total of 64,482 hectares. He figured out the average yield of fields of the same age and got the following figures:

Table X

Planting Year	Age of the fields years	Kilogram rubber per hectare
1923	4-5	71
1922	5-6	223
1921	6-7	271
1920	7-8	291
1919	8-9	321
1918	9-10	352
1917	10-11	372
1916	11-12	417
1915	12-13	392
1914	13-14	393
1913	14-15	436
1912	15-16	467
1911	16-17	441
1910	17-18	435
1909	18-19	434
1908	19-20	398
1907	20-21	432
1906	21-22	375
1905	22-23	394
1900-1904	23-24	449

In representing these figures in a curve, it becomes apparent that the increase-decrease in following years shows several irregularities. It must be taken into consideration, that the average figures have been obtained from rather heterogeneous material from fields of very different productivity. The figures show, that the decrease in production generally sets in not before the 15th-16th year. When we realise, that in the old fields the cultural conditions have often been unfavourable (much soil-wash, no green-manuring, etc.), the tapping system too drastic, the bark renewal poor, it may be expected that the increase in yield with the younger fields will last longer than in the old fields, so that the decrease in yield will set in later than in the fields under consideration.

Selection.—A general review of Hevea selection in Java was given by De Vries, Schweizer and Ostendorf. From this exposition it is apparent that the planting of selected trees, either seedling or budded trees is in Java not yet so general as in Sumatra, but the interest in selection is at present very great and a great number of clones of superior mother trees are grown on different estates: 85 clones at 6 estates are under observation of the Rubber Experiment Station. Three clones of the Estate "Bodjong Datar" (from mother trees of the Estate "Pasir Waringin") have been well tested and could be recommended to the estates; the average production was at the age of 9 years: 6·35 kg., 7·65 kg., and 6·90 kg. rubber (dry) per tree per year.

* From *International Review of Agriculture*, Part I, Year XXI, No. 9, September 1930. Part I of this paper was reproduced in *The Tropical Agriculturist*, Vol. LXXVI, No. 2, 1931.

In 1926 a beginning has been made with the more systematic testing of the different clones. To this purpose different clones have been planted together in one field, each clone in a number of plots (say 3 or 4) of ¼ to ½ ha. each; or the different clones have been planted in rows, each row of no more than 20 trees and alternately a row of the clone to be tested with a row of the so-called "standard clone", i.e., a clone which has already been tested for several years and the production of which is used as a standard. Of each clone two to six rows have been planted. In these experiments the trees have been planted at a rather large distance, viz., at the rate of 240 to 330 trees per ha.

In Ceylon selection as a plantation practice is still rather backward, L. Lord in a lecture delivered in Colombo, gave a general review of the situation in Ceylon and urged the planters to give the policy of rejuvenation a thorough and wide trial, using for all new plantings the best available material and prosecuting energetically research on the production of superior material. He advised strongly to test a great number of estate trees as mother trees and to test foreign clones. If these measures would be taken the lecturer thinks that there would be no reason for pessimistic views regarding the future of the rubber industry in Ceylon.

In selecting the high-yielding mother trees we are still obliged to follow the ordinary way of measuring the yield of the trees during at least one year. We have not a reliable method of estimating the yield by means of correlating characters.

As De Vries showed, it is still uncertain what may be expected from Ashplant's method of measuring the diameter of the latex tube.

As a general tapping system for the trees which must be tested for selection, the alternate-day tapping over 1/3 has been adopted in Java and in comparative experiments three clones (Ct 88, AV 36, and AV 50) are included as "control" or "standard clones." A reliable impression of the productivity of a clone can only be obtained by experimental tapping continued during one year, or, better still, during several years.

A short review is given by De Vries of the Hevea plants imported in Java from Brazil. It appears that practically all the Hevea trees in Java are descendants from the trees grown from seed which Wickham collected in Brazil in 1875.

On different estates a great number of mother trees have been selected and the yield has been recorded during several years. The Besoeki Experiment Station (Djember) and the Rubber Experiment Station (Buitenzorg) kept a number of these trees in regular observation. This collection contains trees which give an average of more than 150 gm. rubber (dry) per tapping, being tapped on alternate days over 1/3; a few trees give more than 300 gm. per tapping.

The simplest method of selecting consists in planting seedlings grown from "illigitime" seeds (seeds obtained by uncontrolled pollination) from selected mother trees. The fields planted with these seeds have shown that in this simple way a remarkable improvement of the production may be obtained. A field of the Estate "Passir Waringin" of 21½ ha. planted in 1916 with such seeds, gave the following yields:

7th	8th	9th	10th	11th	12th	13th	year
390	600	666	820	717	703	745	kg. dry rubber per ha.

A field of the Estate Petaroeman, planted in 1916 and 1917 with "illigitime" seeds from selected mother trees of the Estate Kiara-Pajoeng gave the following yields:

	6th	7th	8th	9th	10th	11th	year
Estate Petaroeman	340	497	573	700	745	775	kg. dry rubber per year per ha
Average production	200	280	360	420	450	470	do do

Artificial cross-pollinations between trees of high yield and specially between trees of the best clones have been effected in Java in the last few years on a large scale. Records of yield of the seedlings are not yet available.

A few estates have made isolated fields planted with two or more high yielding clones. Of the seeds produced in these fields it is certain that father tree as well as mother tree is a high-yielder. From the fields planted with seeds from these fields records are not available either.

Other Hevea species than *H. brasiliensis* have been imported in Java viz. *Hevea collina*, *H. spruceana*, and *H. guyanensis*, but they have not shown any character which seems especially desirable. They have not been used for hybridisation experiments.

The practice of budding has been the subject of various investigations. In Java De Vries and Vrolyk made an enquiry about the results of the budding practice on the estates; seventy-five estates gave the information asked for.

The average percentage of success is still low in Java: only 60%. This may be partly the consequence of lack of training of the labourers to whom the budding work is entrusted, but there are still other causes. One of these is that budding is sometimes effected under unfavourable circumstances, and the enquiry proved clearly that budding is not equally successful in the different months. De Vries and Vrolyk figured out for each estate the success of budding obtained in each month in comparison with the success obtained in the most successful month. The figures thus obtained are combined into the following list:

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Percentage of success (i.e., percentage of the success-percentage, obtained in the best month)	69	72	76	83	76	80	76

These figures show that it is advisable to wait some time after the beginning of the rainy season before starting budding; in October the stock and scion are generally not yet in the best condition for budding.

Vrolyk and Ramaer investigated this question more in detail. They realised that the differences in success obtained by budding in different months is the consequence of the differences in stage of growth of the scion and of the stock. The object of their investigation was to find in what stage of growth scion and stock are most suitable for the budding operation. They proved that the success in budding is greatest when the stock and the scion have just started to make a new sprout and the first leaves of this sprout are still very small and brown in colour. A little later when the new leaves have adopted a green colour and are still weak and hanging the percentage of success is already a little lower but still satisfactory. The older the new sprout of the stock the less suitable it is for budding, and the same is the case with the scion.

The question what seedlings are to be preferred for stock is still a puzzling one; one thing is apparent, viz., that quick-growing seedlings have the advantage of being earlier fit to serve as stock than slow-growing ones. This fact induced Schweizer to investigate whether seedlings of different mother trees show marked difference in quickness of growth. His investigations showed that this is indeed the case, so that "growth-velocity" must be regarded as a hereditary character; quick-growing mother trees seem to give as a rule quick-growing offspring. In using such seedlings some estates were able to perform the budding operation three months earlier: the seeds were collected in March and budding could be done in the beginning of the rainy season (November-December). Schweizer investigated also whether it is advantageous to use large seeds for

growing stock but, though the plants raised from large seeds are in the beginning stronger than plants from average or small seed, the difference is no longer to be seen after a few months. Thus there is no advantage in the use of large seeds for raising seedlings for stock.

As De Vries and Vrolyk mention, a thing which is in Java the cause of much disappointment is the dying off of buds after they have grown together with the stock. This occurs much more in the dry season than in the wet season (22·7% against 4·6%).

Budding in the nursery is in Java more generally applied than budding in the field (87% against 13%) and it has a greater success-percentage, as is to be seen from the following figures:

Table XI—Success-percentage of budding.

	In the nursery	In the field
	%	%
Besoeki (East Java) ...	53	36
Malang (East Java) ...	77	55
West Java ...	52	49

In this connection the investigations of Man in Malaya may be mentioned.

Budding in the field is carried on in Malaya to a great extent (figures are not given), though failures are more numerous than in budding in the nursery. Under nursery conditions it is possible to choose stocks in the best stage of growth for the operation, while under field conditions choice is much restricted. But the advantage is, that in budding in the field the budded plants are not checked in their growth by being transplanted.

Man considers the vigour of growth of stock and scion at the time of the budding operation as the most important factor influencing success, and the unfavourable results obtained with budding under drought conditions, especially on sandy soils, must be attributed to the less vigorous growth.

In order to prevent the dying off of the bud after opening the author advises to protect the bud. This may be done by trying a shade of leaves around the freshly budded stock immediately above the waxed binding. By this measure the newly-formed wound healing cells (callus) are prevented from dying. Another thing, which Man considers as important, is to take care in budding that patch and pannel fit well so that no wide gaps separate the edge of the patch from the cut edges of the bark of the stock. The following figures are given, which illustrate the influence of drought and of shading the bud:

Table XII

Period of budding	Percentage of success immediately after opening the bud	Percentage final success	Loss after opening as a percentage of initial success
Clone 1 Showery (April-May)	98	84	14
Drought (May-June)	99	70	29
Clone 2 Showery (April-May)	88	85	3
Drought (May-June)	80	35	56

Table XIII

Shading		Percentage of success immediately after opening the bud	Percentage final success
Clone 1	Light or none	91	70
	Heavy	99	87
Clone 2	Light or none	57	48
	Heavy	88	84

In Java the most generally applied budding method is the "modified Forkert method"; in East Java, however, some estates apply the "patch budding". The success-percentages obtained by the two methods were as follows:

Table XIV

Estate	Modified Forkert method	Patch budding
Besoeki (East Java)	55%	49%
Malang ,, ,,	76	66

The Forkert method seems thus slightly more successful.

Budding does not succeed equally easily with different clones. In Java for instance clone BD 5 gives the highest success-percentage. Clone AV 152 the lowest. The same experience of different success with bud-wood of different clones has been gathered in Malacca.

About the influence of the stock on the scion we are still entirely ignorant. Dias surprised us with the statement, that "to a certain extent" the growth of the scion is not at all influenced by the stock. He claims that the bud in developing envelope all round the stock, and that the stock "attains a dormant state" and "increases neither in girth, breadth, length or in any other manner."

This statement, which will certainly not be credited by many botanists and planters, was criticised by Taylor. This author lays stress on the fact, that there is a considerable amount of information available on the influence of stock on scion with other plants than Hevea. This information goes to show that while each of the two retains its general characteristics there is a decided interaction between the two. Taylor considers that research work on bud-grafting in Hevea should keep in mind the possibility of such influence. He says that there seems to be an indication that plants budded on their own stocks grow better. In Java the Rubber Experiment Station takes the same stand and an investigation has been started on the influence of the stock on the scion.

The use of cutting off the "snag" flush with the top of the bud was emphasised by Weir. If this is done in the proper way, the cut sloping downward away from the bud, and at the proper time, say when the bud has grown 4-8 ft. and shows considerable brown bark, the amount of decayed wood remaining on the stock may be very little or may be entirely absent. In many cases however, especially if the snag is cut square across or cut too high, the decay may advance so far below the point where the cut is

usually made that an appreciable amount of decayed wood may be sealed in by callus tissues. The decayed wood next to the bud side of the stock may, before the callus is complete, cause the young tree to be overthrown by the wind. Also the shoot may be broken off by the wind if the cut exposes the decay so close to the bud that the callus does not form rapidly at that point.

The packing of budwood is a practical question of some interest, as the budwood must often be obtained from places more or less remote. Billington recorded the success in budding with budwood packed in different ways. The budwood was transported from Siantar (Sumatra) to Kuala Lumpur. The material was sent from Siantar to Belawan by train, from Belawan to Penang by boat and from Penang to Kuala Lumpur by train, a journey which took three days. Three different methods were used: (1) coconut fibre was put between the layers of budwood sticks, (2) each group of sticks was wrapped in a banana-sheath securely tied with string, the bundles so formed being buried in dry saw-dust, (3) each stick was wrapped in dry sacking and tied with string, and each group of five sticks was rolled in a further piece of dry sacking, and tied and buried in charcoal. All three methods of packing have proved suitable. To differentiate definitely between the methods a longer journey is evidently necessary. In the opinion of Billington it seems, however, that the charcoal and sacking method appears to keep the bark in more pliable and tractable condition.

One common objection advanced against budding is that budded trees may not renew the bark so satisfactorily as seedlings and that they will have to be allowed a longer period for bark renewal.

Billington made measurements on the virgin and on the renewed bark of young budded trees of four clones. Tapping was done daily in alternate months on trees budded in the first half of 1924 and transplanted as stumps at the end of 1924. Records of bark thickness were taken on 23-28 July 1928 of parts tapped February 1, April 1, June 1, and July 20, and again taken on 14-18 January, 1929 of bark tapped at the same dates also on August 1, 1928. Fifty-eight trees from four clones were used in these experiments.

From figures given it may be quoted here that in January 1929 the bark tapped 1st February had a thickness of 5·0 mm. (clones B 50 and B 58), 5·0 (clone A 44) and 6·3 (B 85).

The conclusion is that bark renewal in the budded trees is satisfactory so far and that the bark is adequate for tapping.

Often difficulties have arisen from the fact that budwood of different clones had been confused and that budded trees have been planted out under erroneous names. The need was therefore felt to find characteristics which would enable to distinguish the different clones from each other. It was already well known that the seeds are often very characteristic and they have often been of great help in finding out mistakes. But seeds are not always available when we want to be certain to what clone a certain tree belongs and, besides, the seeds of different clones are sometimes much alike. For this reason the Rubber Experiment Station in Java has made a study to find other characteristics which might enable to distinguish the clone in a more satisfactory way. It was found that the form of the leaves, the shape of the leaf scars on the stem, the shape of the lenticles, the way in which the cork is formed on the stem, the shape of the stem, the shape of the buds, etc., are different in the different clones, and that the clones can

be determined with the help of these characters. For a successful determination some training is necessary. The Rubber Experiment Station in Buitenzorg gives regular courses in which the planters are trained in this determination work.

New figures of the best Sumatra-clones were given by Heusser.

Of the clones which have been in observation for several years the Nos. 49, 50, 71, 152, 163, and 256 may be considered as the best clones. The No. 36 is among the foremost as regards yield, but it has the drawback of being very sensitive to wind.

These excellent clones are closely followed as regards yield by Nos. 27, 35, and 53.

Among the clones which have been in observation only during the short time the Nos. 183, 185, 186, 209, and 214 justify full interest and accurate further observation.

The yields of these excellent clones are given in the following list. Tapping has been done alternate monthly (about 185 tapping days per year).

Table XV

Number of clones	Year of planting	Yield per tapping in grams					
		4th	5th	6th	7th	8th	9th year
49	1919	4·0	2·9	20·6	32·5	35·8	34·5
50	1919	6·1	14·7	30·3	34·0	29·5	31·1
71	1922	7·8	12·4	21 8	–	–	–
152	1922	9·7	17·1	23·6	–	–	–
163	1922	9·8	12·7	20·8	–	–	–
256	1920	?	?	?	?	41·7	–
183	1922	?	14·8	24·0	–	–	–
185	1922	?	21·1	35·1	–	–	–
186	1922	?	14·4	20·5	–	–	–
209	1923	–	13·5	–	–	–	–
214	1923	–	14·5	–	–	–	–

It is interesting to compare with these yields those obtained from seedlings from selected trees by artificial pollination.

Heusser gave an account of the tapping results of such seedlings. Thirty combinations of different father and mother trees were investigated. The number of trees of these combinations were different and varied (from three to eighty-three). They were all tapped with one cut over ½ circumference alternate-monthly. As father trees were used the trees 36, 49, 138, 145, 146, 140, 141, 142, 157, 164, 165, and 166; as mother tree Nos. 26, 35, 36, 49, 138, 139, 140, 142, 146, 151, 157, 161, 164, 165, 166.

Cross-pollination was effected in March-May 1930, the seeds were gathered in August-October of that year and the seedlings were planted into the field in October 1921-January 1922. Tapping was started in November 1925. The yields of a few of the best yielding "families" (as a

"family" are designated the seedling descendants of the same father-and-mother-tree) and the average yield of all the seedlings are given in the following list:

Table XVI

Number of father- and-mother-tree	Yield per tapping in grams			Number of trees tapped
	4th	5th	6th year	
157 × 164	10·19	28·19	34·65	32
165 × 161	7·1	24·53	31·65	4
157 × 151	12·73	27·70	30·43	3
164 × 161	7·98	22·34	29·60	28
166 × 161	7·38	23·44	29·21	4
Average of all the seedlings	7·30	18·63	20·24	724

These figures prove that some combinations of parents give seedling families which are not less productive than the best clones.

IDENTIFYING HEVEA CLONES *

REMARKABLE NEW METHOD DESCRIBED BY DR. BOBILIOFF

IN a preliminary communication to *De Bergcultures* (of 27 December 1930) Dr. Bobilioff describes what appears to be an entirely new and very important and remarkable chemical method of distinguishing between Hevea clones.

At present, he points out, a Hevea clone is identified by a subjective examination of the external morphological characters. This method has the advantage that in many instances a great number of buddings can be identified in a short time. It is, however, confined—at the moment—to normally grown buddings in a certain stage of development, and it demands as well as certain aptitude for this sort of work.

In the new "Chemical Method of Identification", on the other hand, the clones are distinguished by a definite chemical reaction of the latex. So far this method has been carried out only in experiments, and Dr. Bobilioff refrains at present from discussing how far it may have practical value.

His discovery is that the latex from each clone gives a definite chemical reaction and that this reaction is fairly constant in all individuals of a clone. One advantage of this chemical method of identification is that the identification is independent of the age of the plants, that is to say the latex from individuals of the same clone but of different ages will give the same reaction. Therefore it is possible to identify with clearness older test gardens.

In applying the method a few drops of latex are taken from young or half grown leaves by cutting through the leafstalk where it is attached to the branch. The drops that appear on the cut surface of the stalk are collected on a porcelain plate, preferably one with depressions. In each depression the latex from one tree of the clone that is being examined is collected. Three to five leafstalks will give sufficient latex for the reaction. To this small quantity of latex is added a reagent concerning which no particulars are given except that it is (1) a new discovery, (2) a colourless solution, and (3) the mixture of latex and reagent is white. In a short time, from half a minute to a few minutes, the latex begins to colour, and this colour increases in intensity.

The time of colouring, the nuances of colour, the intensity of the colour are different in different clones, so that it is possible to distinguish clones from each other.

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* From *The India-Rubber Journal*, Vol. LXXXI, No. 12, 1931.

As an example Dr. Bobilioff takes three clones, namely BD 2, AV 256, and Tjir 1. After adding the reagent, the reaction occurs in about the same time for these clones. After one to two minutes the latex of these clones had assumed a rose colour, which in BD 2, and AV 256 is the same, but a careful examination indicates that in Tjir 1 a weak blue nuance appears to be present. It is in the second stage of the reaction that clear differences between these clones appear. The colour of Tjir 1 is pronouncedly blue, that of AV 256 is red and that of BD 2 is purple. These differences can be seen clearly in the third stage, that is from six to ten minutes. In these three clones the colour of the reaction can be used as a distinguishing character, while the intensity of the reaction and its time differ little.

There are, however, clones that can be distinguished merely by the intensity of the reaction, where, for example, the reaction is very weak and appears only after a long time. In the latex of AV 209 it is only after 45 minutes that a weak coloration begins to be apparent.

The method has been applied to a great number of clones in the experiment garden of the experiment station at Buitenzorg (Java) and also on several estates in West Java, where corresponding results were obtained.

RECENT EXPERIMENTS ON THE BURNING QUALITIES OF TOBACCO *

THE burning quality of tobacco is of special value for all kinds of tobacco used as wrapper. There are of course several other factors, which determine the value of a tobacco leaf as a cigar wrapper, but one of the most important is without doubt its fire-holding capacity.

The Journal of Agricultural Research has published an article on the influence of chlorine on the growth of the tobacco plant and its influence on the quality of the cured leaf. Experiments on light sandy soils and sandy loam soils in North Carolina showed a stimulation of the growth of tobacco by a moderate supply of chlorine in the fertiliser. Under the conditions of the place where the experiment was made a quantity of 22 kg. to 33 kg. per ha. caused the maximum of growth stimulation. It was demonstrated that the presence of chlorine in the soil enables the tobacco plant to make better use of the soil magnesium for nutrition and that a certain amount of chlorine in the leaf improves the resistance to drought. Larger quantities of chlorine however may cause injury to the plant, not by direct toxic effects but by interference with the metabolism of carbohydrates. This injury is more serious on light than on heavier soils. Tobacco leaves from chlorine fertilised plots exposed to various relative humidities after curing, showed that the moisture content was increased. This may influence its elasticity, its combustibility and keeping qualities. Excess of chlorine produced muddy colours in the cured leaf which often showed intermingled colours: green, yellow, brown. The combustibility of the leaf was impaired.

The Tobacco Sub-Station at Windsor (Connecticut Exp. Sta.) in its report for 1929 gives many details on various experiments on tobacco of which those connected with its burning qualities may be shortly reviewed.

Experience showed that dry seasons usually produced a tobacco with poor burning qualities and that the reverse happens when the season has a high rainfall. Analyses of the tobacco of a dry season and of a wet season showed difference in chemical composition, a good burning tobacco having less chlorine, calcium, magnesium, nitrogen, phosphorus, sulphur and manganese and more potash, silica, iron and alumina. A good burning tobacco has a much higher alkalinity than a poor burning one. Even the seconds, usually the best burning leaves, showed a greater alkalinity than the darks from the same plot.

Experiments with potash as a fertiliser showed, that the fire holding capacity of tobacco grown on plots without potash manure diminishes every year. Plots receiving potash however produced a tobacco which did not show any deterioration in this respect. The percentage of potash in the leaf was influenced by the quantity of potash manure, although the soil was very rich in this element. The percentage was increased by applying a larger quantity of potash fertiliser. When the percentage of potash decreased, the same was true in regard to calcium and magnesium in the leaf.

* From *International Review of Agriculture*, Part I, Year XXI, No. 12, December, 1930.

A general relation was observed between fire-holding capacity and the ratio of potash to calcium and magnesium, measured by strip set. A wider ratio was favourable to the fire holding capacity. Differences in this capacity caused by the use of different potash salts, e.g., sulphate, carbonate or nitrate or by the use of tobacco stems, were very small. By applying sulphates to the soil, the percentage of sulphates in the leaves was increased and the burning qualities were weakened.

The Tobacco Experiment Station at Klaten (Java) started experiments on manuring to find a suitable method to apply green manure in relation to the peculiar rotation conditions in accordance with which tobacco has to be carried on. These conditions are only of local interest, but some results may have a more general significance. It has been proved by these experiments: 1. That quality and length were improved by organic manures (dung and green manure); 2. That on phosphorus poor soils length was improved more by dung than by green manure, but that a small amount of P-fertiliser was sufficient to make them equal in this respect; 3. That P-fertiliser had a bad effect on the colour as it hastens the ripening of the leaf, especially in dry years and that not only on P-rich but also on P-poor soils (with only 0·004% cistr. sol. P_2O_5). Dung may therefore also have a bad influence as it contains a considerable quantity of P_2O_5; 4. The fire holding capacity was in general the best after green manuring (*Crotalaria* sp.) because the content of the dung in Cl. is considerably higher than that of the *Crotalaria*. But as the contents of *Crotalaria* augments with age, it should be applied as a green manure not later than after reaching flowering stage. 5. Experiments with fermented green manure showed improvement in length, quality, and colour. The same Station started a very thorough investigation in connection with the fire holding capacity of tobacco leaf, which may be of general interest.

(a) *Method of Examining Fire Holding Capacity.*—In order to examine the influence of various cultural practices on the fire holding capacity of the leaf, the average glowing duration was ascertained by noting, how many seconds each leaf continued to burn, when lit by means of a glowing carbon-point at the bottom of the leaf on the right side between two veins. In order to get sufficient reliability 800 leaves were burnt per test. Owing to the possibility of obtaining an average from a very large amount of experiments, this method was preferred to the "cigar-test".

Of the various burning qualities only the most important, namely the fire holding capacity, has been examined.

The figures thus obtained showed three types of frequency-distribution. The first with leaves of good fire holding capacity showed two summits; one not far removed from the arithmetic mean, the other as a result of leaves showing abnormal burning capacity. This made it impossible to apply the theory of probability and, as the investigation was started to find the causes of low-burning capacity, it was not necessary to spend time on it. The second type appeared by examining leaves with a very short glowing duration; it showed a flowing curve, of which the summit, as compared to the arithmetic mean, had largely shifted towards the side of the short glowing period. Provided that the frequency was expressed not in the time of glowing but in the logarithm of it, it was possible to employ the theory of probability to this case. The third type lay between the other two. The flowing curve did not deviate much from the binomial frequency-distribution and the theory of probability could be applied to observations of the glowing-time.

As the tests proved that the glowing duration was directly proportional to the logarithm of the percentage of moisture, it was possible to apply a correction for differences caused by moisture difference. It was proved that: $\log A - \log B = k \times (a-b)$ in which A represents the corrected glowing duration by a percentage of moisture, and b the moisture—percentage at the determined glowing duration B.

(b) *Chemical Composition of Good and Bad Burning Leaf.*—A chemical investigation of the leaf confirmed the previous observations that a bad burning leaf contained more chlorine and less potash than a good burning one. Although in most cases the percentage of chlorine in the ash was sufficient in itself to settle the matter, it was found that exceptions did occur and that besides the contents in potash, the contents in lime and magnesia were also of influence. The correlation coefficient between average glowing duration per leaf per plant and the amount of chlorine, sulphate, potash, calcium + magnesium expressed by the quotient

$$\frac{K_2O}{Cl \times (CaO + MgO)}$$

were calculated from the average glowing duration, computed for some nineteen separately harvested plants growing side by side in one test field and where thus the influence of different soil conditions was eliminated.

The correlation coefficients between the period of combustion and the proportion of the different mineral elements in the ashes of the leaves are shown in the following table:

	Mineral elements in the ash				
	Cl	CaO + MgO	K_2O	SO_3	$\frac{K_2O}{Cl \times (CaO + MgO)}$
Correlation coefficients	−0·7	−0·2	+·04	0·0	+0·8

(c) *Influence of Manuring on Fire Holding Capacity.*—It has been proved, that the glowing period does not improve by fertilising. Among the organic fertilisers it was found that straw manure (fermented rice straw) and dung most seriously harmed the glowing capacity of the leaf. Oilcakes (kapok seed, coconut, groundnut, etc.) and *Crotalaria* choppings used as green manure had little or no injurious effect. The injurious effect was closely associated with the amount of chlorine in the organic fertilisers.

Also the usual inorganic fertiliser, sulphate of ammonia, if necessary supplemented with double superhosphate, is detrimental, although to a less degree than dung. Contrary to what was expected after the chemical examination of the tobacco, no improvement was recorded after the use of potash fertiliser.

(d) *Influence of Soil Conditions.*—The occurrence of non-burning tobacco was found to be most prevalent in places where quantities of chlorine existed in the soil moisture. It is therefore probable that all measures to soil-capillaries will be of value, whereas those precautions that tend to increase these soil capillaries will prove disadvantageous. In fact the early inundation of the soil, by which the soil particles are able to coalesce more closely, has disastrous results on the fire holding capacity.

(e) *Breeding Good Burning Varieties.*—A large number of plants grown side by side or close together under identical circumstances and harvested separately, showed that great differences are to be found with regard to the average glowing period per plant.

The hereditary character of these differences was also proved.

Among the chief practical measures for the improvement of fire holding capacity the following may be mentioned:

1. Improvement of drainage and system of tillage. 2. Replacing dung by green manure. 3. Avoidance of all not strictly necessary flooding. 4. Careful adaptation of sowing and transplanting dates to weather-forecasts. 5. Some reduction in planting distance. 6. Avoidance of excessive heating in the drying sheds.

(f) *Influence of Climate.*—Burning capacity however does not depend only on soil factors as climate also plays an important part. The Experiment Station of Scafati (Italy) started in 1929 an experiment to prove the influence of climate on combustibility of Kentucky tobacco. In the community of Bibbiena second class tobacco is produced and in the Valle di Chiana only a fourth class. Four wooden cases, each about $\frac{1}{2}$ m^3 were filled with earth, two of them with soil from Bibbiena and two with soil from Chiana. The two containing Bibbiena soil were transported to Chiana and placed in a field at Chiana and with the other two the process was reversed. It was possible in this way to cultivate tobacco in Chiana soil at Bibbiena and vice versa at the same time with the surrounding tobacco plants growing in untouched soil.

The result has been that the tobacco cultivated in Chiana soil at Bibbiena has not been influenced by the climatic conditions of that place; in regard to its combustiblity it belonged also to the fourth class, as that grown at Chiana itself. The tobacco cultivated in Bibbiena soil at Chiana however was influenced by the climatic conditions: it belonged also to the fourth class while at the same time the same tobacco grown at Bibbiena produced a second class product.

THE CLOVE INDUSTRY IN ZANZIBAR *

(*A*) *Production.*—It is impossible to deal with the industry of paramount importance to Zanzibar—clove growing—in a report confined to events falling within the calendar year. That report, written in October last, carried the review of the industry up to end of June, 1929, and indeed it was possible to remark upon the commencement of the 1929-30 harvest.

In this report we are, therefore, concerned with the season commencing in July, 1929 and terminating for statistical purposes at the end of June, 1930.

The previous season—1928-1929—having been an unusually poor one, cloves brought to town during July to June having amounted to only a trifle over two lakhs of fraslas (say 3,100 tons), it was only to be expected that the 1929-30 season would be unusually good. Expectations were realised and the season established a record.

Exactitude in statements of the measure of crops is an impossibility. Even when all cloves produced in the country had to pass through the Customs on entering town for the purpose of excise it was not necessarily the case that all the cloves picked between July and February, the normal limits of the harvesting period, were brought to market between July and the end of June, nor that all the cloves brought in during that period belonged to that particular harvest. I have known four-year-old cloves brought into town from the plantations, though this is very unusual.

Estimates have to be made of stocks from previous years brought in and hold-overs carried by the producers. Although old stocks coming in can be distinguished from new season's produce it frequently happens that, being drier, they are mixed with the new to enable the bulk to pass the standard required by the Produce Export Decree. As an estimate of the season's crop is fundamentally based upon the deliveries at the Customs, and such was not obligatory during the past two seasons, excise having been taken at the time of export only, even the fundamental data have been lacking in the accuracy of former years. The clove deliveries we may characterise as the raw figures to distinguish them from those which the Comptroller of Customs prepares to represent so far as can be ascertained by the quantity produced during the season.

In the season 1928-29 the deliveries were given as 200,568 fraslas, and during 1929-30 as 928,943. The latter raw figure requires various adjustments to allow for hold-over and parcels brought to town but not passing through the Customs House for weighing, and the Comptroller of Customs is of opinion that the season's production must have reached at least 10 lakhs of fraslas (over 15,500 tons) and therefore have beaten the previous record of 9·8 lakhs in the season 1922-23. Early in 1930 it was realised that the succeeding crop would be an almost complete failure.

The tremendous variation in size of crop from season to season has not so far received an explanation. Precisely what effect it would have upon the market if future crop could be foretold it would be difficult to say. Speculation quickens interest, and the uncertainty of the future position must necessarily lead to competition in buying stocks. There is probably hardly another crop in which it is such a gamble to deal. Growers and

* From the Annual Report of the Agricultural Department of Zanzibar Protectorate for 1929.

merchants alike must speculate on the probability of the next crop and it is in vain that we look through the records of the past to give us a clue to the future.

An apparently safe system for the producer to adopt is to hold a proportion of his crop in years of great plenty; to hold very little when the crop is average and to sell that at the first sign of a large succeeding crop; to sell hold-over gradually and not expect to get the top price of the year for the whole of it.

Before attempting to peep into the future it is well to consider this question of variation in size of crop critically.

When I visited Singapore in 1924, the Director of Botanic Gardens there drew my attention to some clove trees which, though quite well developed, practically never produced a bud, whereas at Penang, about 380 miles way, clove production is an important industry which leads the world as regards quality. Mr. Birkill expressed the view that the difference in behaviour of the trees in the two islands was capable of a simple explanation, viz., that in Singapore the climate is uniformly moist whereas in Penang there are distinct dry periods, as in Zanzibar, and that this stimulus is necessary to cause the trees to flower.

Now were flowering a simple reaction to a climatic stimulus there would be no difficulty in correlating crops with meteorological observations, but so far a correlation has not been found. The Dutch botanists who have studied the tree in its native habitat state that the clove only flowers twice in three years and will bear heavily once in from four to seven years. Periodicity in flowering is a general phenomenon, that it to say that flowering plants have a tendency to flower at certain periods apart from any external stimulus. The coconut palm flowers every 26 to 30 days, many plants flower twice a year, some annually, others only once in their existence. The clove tree appears to have an obscure periodicity so that the effect of the external stimulus—climate—is obscured. The same stimulus will only produce the same reaction if the tree is in the same phase. There is also a clear indication that when the external stimulus acts upon the trees when in a phase preparatory to flowering an abnormally large crop results, but a reaction follows, presumably due to temporary exhaustion, and the trees will completely miss flowering for a season. There is a kind of oscillation produced and the pendulum does not come to rest at once, large and small crops alternating for perhaps four seasons.

We have probably three factors to take into consideration:

(1) The nature of the climatic stimulus.
(2) The phase in the periodicity of the trees.
(3) The reactions from a previous stimulation.

Obviously unless these factors are known and measured the resultant—the future crop—cannot be predicted.

During the first half of 1930 the trees certainly received a stimulus in the way of a dry period, and some of them will unfortunately never flower again. The dry period—May to August—was, however, not altogether seasonable, and it does not appear to have produced any tendency on the part of the trees to produce buds for the December-January portion of the crop. How many weeks or months pass before the effect of a stimulus is visible to the eye is not known, so that were we more certain even of its nature we should still be unable without further knowledge to gauge the effect upon a forthcoming crop whose size may be affected by the conditions obtaining only during a particular and short interval of time.

Our peep into the future—the season 1931-32—cannot therefore be made with anything approaching safety. We do not know how the past, present, or future climatic conditions will modify the trees' inherent tendency. There has been a violent oscillation, two lakhs, ten lakhs, the present (1930-31) crop of less than two lakhs. The oscillation would tend to carry the future crop upwards, but it is obvious that we are too near the last phase of the heavy bearing period for it to appear again, and a rather above average, say 6½ lakhs, crop would appear to be the most probable event.

In my last annual report attention was drawn to what appeared to be the repetition of a previous cycle, and the following figures will be found of interest :

Season	Fraslas	Season	Fraslas
1913-14	7,83,680	1924-25	7,61,412
1914-15	5,26,309	1925-26	6,11,814
1915-16	7,96,757	1926-27	7,33,209
1916-17	5,11,635	1927-28	6,90,752
1917-18	2,98,197	1928-29	2,00,568
1918-19	8,24,502	1929-30	10,00,000
1919-20	2,62,550	1930-31	1,75,000
1920-21	5,48,277	1931-32	6,50,000
1921-22	2,66,802	1932-33	?
1922-23	9,81,915	1933-34	?
1923-24	3,11,794	1934-35	?

The chief object in discussing the apparently fortuitous variations in the clove crop is to draw attention to the nature of the problem in the hope that observers in this and other countries will give some attention to the matter. It is possible that experience elsewhere with fruit or forest trees may put us in possession of the means to unravel the knot, and suggestions would be most gratefully received.

(*B*) *Finance.*—It is inevitable that violent fluctuations in production should be accompanied by corresponding fluctuations in price. Some idea of these fluctuations will be gathered from the following figures of the average price of Zanzibar cloves for the month, with duty added.

Date	Duty paid price Rs. per frasla Rs. Cts.
1929	
January	30 98
March	33 91
June	31 95
September	16 50
1930	
January	14 74
March	18 65
June	19 84
September	22 21

There has during the past two or three years been a movement on foot in many parts of the world to stabilise production with the object of steadying prices. The general principle of making the supply fit the demand; of managing that the production is economically carried out; and of arranging that the consumer is supplied regularly at a price satisfactory to all parties, has been called "Rationalization."

To what extent this principle can be applied to the Clove Industry has been the subject of much thought by many minds. In the early part of the year under review a Committee was appointed to consider the matter generally. That Committee did not reach any agreement but the views which were expressed by members, in many cases very divergent, were subsequently published with the object of stimulating thought upon the matter.

Possibly the word "Rationalization" is unfortunate. It cannot be translated into Arabic or Kiswahili in thought or word. The general impression gathered by the producers was that cloves should be "rationed" like food to soldiers, and the idea left them wondering. It was generally considered that we were dealing with a very difficult and abstruse matter, and the more the subject was discussed the further we appeared to get from understanding it. A speck of dust under the microscope becomes a boulder, and the smoothest pavement a land of impenetrable mountains.

Laying aside the rationalizer's microscope this simple issue appears:

Production of cloves cannot be stabilised. If the producers find it inconvenient to have a good income one year and practically none another they must not sell all their cloves at one time. If the consumers find it inconvenient to pay 1s. 6d. per lb. for cloves one season and 9d. per lb. another they must buy more freely when cloves are plentiful. One or the other must hold stocks. Whoever complains has the remedy in his own hands.

If the producers and consumers were rational the question of rationalizing the industry would not arise. It would not seem unreasonable to put our own house in order before attempting to dictate to people overseas how much and when they should buy.

Comparing the two seasons 1928-29 and 1929-30, the former a two lakh crop and the latter in the region of a ten lakh crop, the average selling prices per frasla duty paid during the twelve months of each season were in the former Rs. 28-15 for Zanzibar and Rs. 27-98 for Pemba, and in the latter Rs. 18-29 for Zanzibar and Rs. 17-55 for Pemba. Considering the size of the 1929-30 crop the prices were very satisfactory and could not have been maintained had there not been a very distinct effort at internal "rationalization" in the shape of holding over stocks. It is estimated that something like 2½ lakhs of fraslas (3,900 tons)—more than twice the maximum production of Madagascar (our only serious competitor)—were held from the market. This indicates the strength of our position in the producing world.

During the twelve months ending June, 1929, Zanzibar had exported 7·48 lakhs (11,700 tons) and Madagascar ·54 lakhs (850 tons) of cloves. Neglecting the smaller contributions from other countries (perhaps 400 tons) it is evident that at least 12,550 tons of cloves were bought during the period in which the Zanzibar price was about Rs. 18 per frasla duty paid.

Overseas stocks do not appear to have increased and there is every appearance of this quantity having been actually consumed.

The twelve months July 1930 to June 1931, will have available some

3,900	tons Zanzibar hold-over
3,000	tons Zanzibar new crop
1,500	tons Madagascar
8,400	

This estimate shows that world supplies are 33 per cent less than the previous twelve months' consumption. At the moment of writing the duty paid price of Zanzibar cloves is about Rs. 24 per frasla. It would undoubtedly have been much higher had not the very important Indian market been dull owing to the general trade disturbance.

(*C*) *Inspection of Cloves.*—The Agricultural Produce (Export) Decree, 1929, came into force on August 17th. The object of this Decree is the same as that of the Agricultural Produce (Adulteration) Decree, 1927, which it revoked. The new legislation was necessary as experience had shown that the earlier decree was faulty, particularly in regard to fixation of responsibility as between owners, agents, shoppers, etc. Under the first decree it was an offence to deal in cloves which did not comply with the standards of quality laid down. Control could be exercised from the plantation to the wharf. The present decree limits control to the wharf, and therefore greatly reduces the amount of work involved in inspection. Refusal to permit exportation is the only punishment in the case of produce unfit for export being offered, but that this is a sufficient deterrent from attempts to ship such produce will appear from the following:

	August 17th to December 31st, 1929.		
	Examined	Passed	Failed
Consignments	1,139	1,115	24
Bales	91,955	89,320	2,635
	January 1st to June 30th, 1930.		
	Examined	Passed	Failed
Consignments	857	848	9
Bales	60,624	60,127	497

Of the 1,52,579 bales of cloves, representing 1,996 consignments, examined between 17th August, 1929, and 30th June, 1930, 97·9 per cent passed, these representing 98·3 per cent of the consignments.

The rapidity with which merchants adapted themselves to the new conditions imposed upon them by the decree is remarkable, but it must be remembered that the previous Adulteration Decree had already effected a tremendous improvement in the quality of produce coming into the market.

The members of a Committee advising upon the nature of the new decree were divided in opinion as to the desirability of retaining powers of control before the actual time of export, some fearing that the producers would not respond to the law unless pressure were applied directly to them with the result that the onus of conditioning cloves would fall upon the exporter and that he would necessarily give a very low price for produce desirously below or suspiciously near the standards prescribed. Particularly was this fear felt in regard to Pemba cloves as the producers were further away from the point of export and their produce would have changed hands many times before it was subject to examination.

How far these fears were justified will appear from the following figures supplied by the Comptroller of Customs:

(a) Before the Export Decree came into force

	Rupees per frasla		
Period	Zanzibar	Pemba	Difference
	Rs. Cts.	Rs. Cts.	Rs. Cts.
1925-26	16 83	16 86	0 03
1926-27	13 77	13 71	0 06
1927-28	12 85	12 64	0 21
1928-29	28 15	27 98	0 17

(b) Decree published

1929			
July	20 07	19 07	1 00

(c) Decree in force

	Rs. Cts.	Rs. Cts	Rs. Cts.
August	16 00	13 02	2 98
September	13 20	12 20	1 00
October	14 51	13 57	0 94
November	12 96	12 16	0 80
December	12 26	11 64	0 62
1930			
January	11 44	10 90	0 54
February	12 20	11 82	0 38
March	15 42	15 35	0 07
April	18 61	18 53	0 08
May	17 66	17 38	0 28
June	16 71	16 54	0 17

(July 1929—June 1930, Excise Duty Rs. 3-30 to be added).

These figures do not represent the extreme fluctuations caused by the decree, but they enable a measure to be taken of the loss to Pemba through its failure to meet requirements. On the quantities changing hands the loss during the year must be in the neighbourhood of four lakhs of rupees.

The plantation owners undoubtedly prefer to lose money than to be subject to direct pressure and the above figures whilst indicating how severely they have punished themselves also show that after about six months they recovered their position.

From time to time the question of grading cloves has been raised. It is perhaps not fully understood in the overseas markets what is the precise nature of the Government control in Zanzibar. Formerly cloves were frequently shipped quite wet, due either to careless preparation, deliberate adulteration, or accidental damage by rain or sea-water. Also large proportions of stems and other foreign matter were frequently present, again due either to careless preparation or deliberate adulteration. The inspection at present is directed exclusively towards preventing the exportation of cloves containing more than 16 per cent moisture or 5 per cent foreign matter. Although the decree provides for rules being made for prescribing grades of quality such rules have not been laid down. It must clearly be understood, therefore, that a certificate of quality under the decree only takes account of these two factors and does not purport to reflect upon the quality of the produce from any other point of view. Weather-beaten wind-fall cloves, the colour of ashes, swept up from the ground at the end of the harvest will, if they contain less than 16 per cent moisture and 5 per cent foreign matter, pass the test.

The Zanzibar Chamber of Commerce has recently given careful consideration to the advisability prescribing a limit to the proportion of withered cloves (locally called Khoker) which shall be permissible in cloves. At first sight this appears to be a sound and simple proposition. If ordinary or normal cloves were of a regular and definite appearance the addition of khoker could be detected and its amount determined. Unfortunately the appearance of normal cloves varies very greatly depending upon the precise stage of ripeness when gathered from the tree and upon the climatic conditions and methods of handling obtaining during the dry period.

If there is wet weather during a heavy harvest the producer is unable to protect his cloves. Heaped in sheds they degenerate and if left spread out in the rain the colour is washed out of them. Under these circumstances a large proportion of the crop becomes wrinkled and discoloured and, in fact, indistinguishable from the khoker obtained from plantation sweepings.

When the bulk of a sample is bold and bright, with a proportion of dull, wrinkled and discoloured cloves, it is obvious that the material has not been wholly prepared under the same conditions and is therefore a deliberate blending. The proportion of each quality present can easily be determined. When, however, the bulk is dull and discoloured it is impracticable to make any definite separation on an appearance basis.

The quality of a sample should be gauged by

1. Dryness.
2. Freedom from foreign matter.
3. Colour (reddish-brown, dark-brown, black, dull or bright).
4. Form (with or without crown, smooth or wrinkled, etc.).
5. Size (weight per 100 cloves).
6. Oil content.

The present inspection guarantees a product satisfactory as regards 1 and 2. If grading were established 3, 4, and 5 would have to be taken into consideration and the grades determined in relation to these factors. Item 6, perhaps the most important one of all—it is the oil in the clove which alone gives it any value whatsoever could not be undertaken as part of any general inspection, but the oil content of any sample can be obtained on payment of a fee.

In the grocery trade, including in that term the supply of cloves for all culinary and chewing purposes, colour, form and size, are important factors. The oil distiller can have no real interest in anything beyond the oil content, though he may perhaps, mistakenly regard the general appearance as a good guide to that point. The spice grinder is more interested in the oil content than in anything else as it is this which gives strength to the spice. Colour, however, may be some consideration to him.

Government is quite willing to undertake any grading which can be shown to be in the best interests of the industry and of this country. It is obvious that the consumers should indicate their requirements and to what extent they are prepared to pay a premium for the particular quality of produce which best meets their need. The producer would be prepared to offer fair-average-quality and premium cloves, the buyers would doubtless prefer fair-average-quality and discount cloves!

I have frequently observed very small differences in price between samples at the opposite ends of the scale. At the present moment with cloves at Rs. 24 per frasla duty paid, half a rupee is only 2 per cent of the price but represents buyers' opinion of the difference in value between the best cloves obtainable and some quite inferior produce.

Is grading therefore really required?

For the present at any rate the consumers must rely upon their agents or shippers to select for them the quality which they require. The best cloves are bought for the best price. If the consumer pays that price but gets "Khoker" he should change his agent. There are many firms in Zanzibar with long experience in shipping cloves to all the markets of the world and the Chamber of Commerce would always provide a list of such merchants on application.

(*D*) *Artificial Drying of Cloves.*—Rumphius, the 17th Century Dutch botanist, states that in his day cloves were covered with leaves and for some days subjected to a smoky fire. That was in Amboyna, the home of the clove. Nowhere in the world does fire-drying of cloves appear to be practised at the present day.

The question of artificial drying of cloves has been considered in this country from time to time, the first recorded experiments having been carried out by Mr. Lyne some twenty-seven years ago, though at a much earlier date hot-plates had been advocated but, so far as I know, not tried in practice. The 1903 experiments were more particularly tests on drying under glass, which process Mr. Withycombe is again exploring.

The Department of Agriculture experimented with fire-drying during the 1927-28 and 1928-29 seasons, reference to which was made in the previous annual report. During the 1929-30 season the crops on the Government Plantations were leased and there was no opportunity of carrying out field experiments on the subject; laboratory tests were, however, made to ascertain safe temperatures for drying so that loss of oil should not ensue. With the coming into force of the decree prohibiting the exportation of cloves containing more than 16 per cent moisture it was anticipated that some form of conditioning plant in the town would become necessary.

The merchants were quite convinced that it would be impossible for them to bring the cloves into condition for export—they then proceeded to do it! For a month or two Zanzibar was tronsformed into a drying ground. Public and private open spaces, school playgrounds, roofs of houses, even roads and foot-paths, were covered with drying mats and cloves. The merchants certainly made the careless producers pay for the trouble involved, but their enterprise in carrying out the conditioning was admirable. During the period from the commencement of the decree, 17th August until 31st December, there was a normal amount of rain and a lot of wet cloves were brought into town (as witness the variation in price referred to) and yet of the 91,955 bales examined, only 2,435 were rejected on the score of moisture. Of these 1,328 were removed from the Customs, dried and replaced, in time to catch the ships by which they were intended to be shipped. Only 1,107 bales (1·2 per cent) of all the cloves brought to the wharf during this period actually missed shipment on account of excessive moisture.

The producers have, since August 1929, learned something of their lesson and it now seems doubtful whether money spent on a mechanical drier would be a good investment.

The department invoked the aid of the Imperial Institute in ascertaining the probable outlay necessary to provide drying machinery for conditioning cloves. The proposals of a number of firms have been received but of their suitability for clove drying there is, of course, no experience.

It was intended to make further experiments to test the applicability of the different systems of drying to our produce, but the clove harvest ended so abruptly that green cloves became unobtainable before much could be accomplished.

The conclusions arrived at were:

1. Hot air drying by natural draught is unsuitable. Quick drying is essential to obtain a good colour and air must be either at too high a temperature or else be under forced draught to remove the moisture at a satisfactory rate.

2. Drying on mats over a sand-bath type of kiln such as is used on Government plantations for preparing copra is very successful if the green cloves are spread at the rate of 1½ lb. per square foot, turned over at intervals, and the temperature not allowed to rise above 60° Centigrade. Under these circumstances the cloves dry out to a moisture content of 10 per cent (drier than required by the decree) by the end of the second day—actually only being hot for about 12-15 hours—and present a very good appearance, better in fact than the sun-dried article.

   Analysis of material thus produced shows that there is no material loss in oil our material yielded 19 per cent essential oil with slightly less than 10 per cent moisture.

It is proposed next season to utilise the copra kilns on Government plantations whenever the weather interferes with sun-drying. It is worthy of note that after the first few days of careful attention by Mr. Raymond or myself the kilns were left entirely in the hands of the native plantation staff and not a single clove was damaged. The remarks on this subject in my last annual report were too pessimistic though it must be remembered that our native staff is perhaps more disciplined than that found on plantations generally.

The natives themselves were enthusiastic over the matter and consider that we need no longer trouble about the weather in clove harvest time. The produce commands a premium on the market.

(*E*) *Regeneration of Clove Plantations.*

(*F*) *Local Distillation of Clove Oil.*—Attention has continued to be paid to these important matters and it is confidently hoped that before the end of another year definite knowledge of the economic position in relation thereto will have been acquired.

MEETINGS, CONFERENCES, ETC.

RUBBER RESEARCH SCHEME (CEYLON)

MINUTES of a meeting of the Board of Management held at 10 a.m. on Thursday, February 19, 1931, in Committee Room No. 1 of the Legislative Council Chamber.

Present: The Hon'ble Dr. W. Youngman (in the chair), Messrs. A. S. Collett, A. E. de Silva, B. F. de Silva, C. E. A. Dias, J.P., J. Farley Elford, J. A. D. Finch Noyes, the Hon'ble Mr. H. R. Freeman, Messrs. F. H. Griffith, J. D. Hoare, C. A. Perera, D. C. Senanayake, and Mr. J. I. Gnanamuttu (Secretary).

Apologies for absence were received from Mr. C. W. Bickmore and Colonel T. Y. Wright.

Mr. T. E. H. O'Brien, Chief Technical Officer, was present by invitation.

The Chairman announced that the House Committee of the Legislative Council had allotted a Committee Room for the use of the Board until the introduction of the New Constitution. The Board appreciated this action of the House Committee and recorded its thanks.

1. MINUTES

The minutes of the meeting held on December 5, 1930, copies of which had been circulated to members of the Board, were taken as read and were confirmed and signed by the Chairman.

2. ANNUAL MEETING

The Chairman submitted that, as the funds of the erstwhile Rubber Research Scheme were expended up to December 1930, the annual report and balance sheet would be presented to a general meeting of the subscribers as had been done in the past years. It was also necessary to obtain the consent of he subscribers to handing over the assets, liabilities and staff of the Old Scheme to the Board of Management. Mr. Farley Elford suggested that the views of the old subscribers regarding the appointment of a Director of Research might be useful. Mr. B. F. de Silva submitted that the Board of Management had full authority in the matter. It was decided that the Board should take all responsibility for appointments. Mr. Dias stated that a date in April had hindered a fair attendance at past general meetings and proposed a date in March. The Board approved provisionally of March 26, and desired that the draft report and balance sheet be circulated as early as possible to members of the old Executive Committee and of the present Board of Management.

3. ACCOUNTS

(a) The statement of receipts and disbursements of the Board of Management for the quarter ended December 31, 1930, was passed. The statement showed a credit balance at that date of Rs. 79,713·09.

(b) The statement of receipts and disbursements of the London Advisory Committee for the quarter ended December 31, 1930 was passed. The statement showed a credit balance at that date of £49.3.11.

The Chairman reported that £500 had been remitted to the London Advisory Committee in the current year and proposed that a further sum of £1,000 be now remitted to finance the work in London up to the middle of the year.

(c) The Chairman read the following suggestion from Messrs. Duncum, Watkins, Ford & Co., the auditors of the Old Scheme:

"*London Vulcanising Plant.*

We would suggest that this be written up to the equivalent of £850 which is the valuation which the London authorities placed on this plant in April 1930, and that the excess over the present book figure be credited to a London Plant Reserve Account and we shall be glad to hear if you approve of this. The present book figure is Rs. 4,849·64 and this procedure would result in this asset being increased to Rs. 11,333·34 (viz: £850 at Exchange 1s. 6d.)."

In reply to Mr. Dias the Chairman stated that the suggestion involved only a book transaction. Mr. Collett supported the auditors' view. The suggested procedure was sanctioned.

4. STAFF

(a) *Director of Research.*—Copies of the advertisement sent out for publication in two consecutive issues of "Nature" were circulated. The Chairman stated that copies would be posted to institutions and individuals likely to be interested in the appointment. At Mr. B. F. de Silva's suggestion, the Board approved of the advertisement being inserted twice in the London "Times". It was mentioned that Mr. R. G. Hatton of the Horticultural Research Station, East Malling, Kent, would arrive shortly in Ceylon and might be able to help with suggestions. The Chairman stated that he would consult Mr. Hatton.

With regard to the posts of Physiological Botanist and Geneticist, the Chairman submitted that it would be advisable to defer the advertisement to a later date.

(b) *Chemist.*—The Chairman reported that Mr. T. E. H. O'Brien had asked that his new agreement should be on the same lines as those of the Tea Research Institute, and that the Coconut Research Scheme was adopting the same policy. Mr. B. F. de Silva suggested that the draft of the proposed agreement be submitted to members of the Board of Management. The Chairman stated that the lawyers of the Scheme who were to be nominated that day, should be consulted, and undertook to circulate the draft agreement as settled by the lawyers.

A letter from Mr. O'Brien was read suggestng that 3 months' home leave be granted to him as from April 22, and that the balance of leave due to him be availed of after the new Director of Research had settled down. The Chairman recommended that the extra passage cost involved be accepted in view of the consideration Mr. O'Brien had shewn for the interests of the Scheme and his conscientious work. Mr. O'Brien was then called in and questioned whether it would be advisable for him to take, say six months' leave straight away. Mr. O'Brien replied that a good many things could be shelved during an absence of three months, but a hiatus of six months might prove detrimental to the Scheme, although in his personal interest a longer period of leave would be acceptable. Mr. Dias submitted, now that Nivitigalakele Station was greatly improved, the Scheme might mark time till it secured its full staff, and seeing that most of the estates were not doing much work, the Board could spare Mr. O'Brien at the present time. It was resolved that the full leave due to Mr. O'Brien be granted to him now at one stretch, and that a fresh agreement with the new Board be drawn up. The Chairman mentioned that the erstwhile Executive Committee had agreed to allow Mr. O'Brien, in the event of his continuing in service, the same leave privileges as were enjoyed by permanent employees of Government. The Board agreed that the period of leave allowable under these conditions be determined by Mr. Bickmore.

Mr. Dias suggested that at future meetings the Chief Technical Officer be called in only when his advice was necessary upon any particular item on the agenda. This was agreed to.

(c) *Mycologist.*—The Board approved of the provision of a free passage for Mrs. Murray when Mr. Murray, who married recently, was due for home leave.

(d) *Agricultural Assistant.*—A letter from the Chief Technical Officer recommending that the services of Mr. Pieris be retained by the Board was read. The Chairman stated that Mr. Pieris had been appointed for a period of six months, and it was difficult to say at present what position he should occupy in the permanent scheme. Mr. Dias suggested that Mr. Pieris should continue in his temporary appointment until the arrival of the Director of Research. Mr. A. E. de Silva urged that Mr. Pieris should be offered a permanent appointment, considering his qualifications and the work he had done. He proposed that the Board should enter into an agreement with Mr. Pieris as Agricultural Assistant, subject to his transference to any other post in which he might be required by the Director of Research with the sanction of the Board. Mr. Senanayake seconded the motion and it was carried.

(e) *Provident Fund Scheme for the Staff.*—The Chairman informed the Board that the Coconut Research Scheme had requested Mr. Bickmore to draw up a Scheme of Provident Fund. The Board resolved that a similar Fund for both the Schemes was desirable and that Mr. Bickmore be asked to draw up such a scheme.

5. EXPERIMENT STATION

(a) The following resolution was moved by Mr. Dias:

"That the Board should take immediate steps to secure the forest land of three hundred odd acres in Pasdun Korale, Kalutara District, offered by Government to the Rubber Research Board for rubber research work."

Mr. Dias urged that the land at Liniyawa be secured, but that the utilization of it be deferred for further consideration. The Chairman drew attention to the memorandum of the Chief Technical Officer which had stressed the necessity of experiments upon the rejuvenation of an existing estate in preference to the planting up of new land. There was an estate which appeared to be suitable between Culloden and Nivitigalakele with an area of Crown jungle in proximity. This would keep the work in a compact area. Mr. Dias urged that it would be easier to prove a clone with new land than with old land, and new land could be bought very much cheaper. He thought that, for the purpose of rejuvenation, Nivitigalakele might be considered an old estate. The most pressing matter was replanting in its various aspects, and estates of varying types of soil would be wanted for that purpose—possibly estates in different localities. After further discussion, it was resolved that the reservation by Government of the 300 acres of forest land at Liniyawa for the purposes of the Scheme, be ensured, but that such acceptance should not involve any obligation to develop this land until the Board was in a position to do so. The Chairman was asked to interview the Colonial Secretary and to report at the next meeting whether or not this land would be reserved for the Scheme on such conditions. Mr. Dias further suggested that the Colonial Secretary be asked what other Crown land may be available for the purposes of the Scheme.

It was further resolved that investigations be undertaken into the question of rejuvenation of existing rubber. Mr. Griffith mentioned there was planted land available round about Moragalla. Mr. Dias stressed the

necessity of knowing one's clones before attempting rejuvenation, and suggested that as Dr. Cramer would pass through Colombo in May next his advice be sought as to how the Board should proceed. The Chairman enquired if there was any possibility of new land being opened out in Ceylon, and members doubted such possibility. Mr. Collett urged that as the persons who now provided the funds of the Scheme were the existing estate owners, the investigations of the Board should be principally in their interest. The view was accepted that the acquisition of developed land for the purpose of rejuvenation experiments was of immediate necessity.

It was proposed by Mr. Griffith, seconded by Mr. Farley Elford, and carried unanimously: that a Committee be appointed to take immediate steps to ascertain what properties were available for purchase for the purpose of experiments in rejuvenation in the rubber-growing districts. Mr. Collett proposed that the Committee should consist of Mr. F. H. Griffith (Convener), Mr. C. E. A. Dias, and Mr. B. F. de Silva, This was seconded by Mr. Freeman, and carried. Mr. Dias suggested a limit of about 50 acres each in (1) Matale, (2) Kelani Valley and Kegalle and (3) Kalutara Districts, and that no estate be visited until after the Committee had reported to the Board. This was agreed to. The Secretary was directed to communicate with District Planters' Associations, notifying them that it was the intention of the Board to undertake rejuvenation experiments on three small areas of old rubber and that the Board was prepared to consider offers of land of 50 to 100 acres. All offers received to be forwarded to the Estate Committee in the first instance.

It was understood that the working of three stations at the same time was a question of finance, which should receive consideration before any estate could be purchased.

(b) *Building of Bridge.*—The Chairman reported the completion of the bridge on the Nivitigalakele Experiment Station approach road, under the supervision of Mr. F. G. C. Busby, at a cost of Rs. 3,252·06, and suggested that Mr. Busby be thanked for his assistance and paid an honorarium to meet his out-of-pocket expenses in petrol, etc. This was agreed to, and on the motion of Mr. Freeman, seconded by Mr. Senanayake, an honorarium of Rs. 300 was sanctioned.

(c) *Accounts of the Experiment Station.*—The Chairman invited the opinion of the Board whether the detailed monthly expenditure statements of the Station should continue to be circulated to members. It was decided that circulation was not necessary, but that the accounts be tabled at the meetings of the Board and be available for inspection by any member at any time.

(d) *Assignment of the Lease of Nivitigalakele.*—The legal position of the Board regarding the Crown land at Nivitigalakele in favour of the erstwhile Rubber Research Scheme was referred to the opinion of the lawyers of the Scheme.

6. REPORTS

(a) The progress reports of the technical officers for November and December 1930, and January 1931, copies of which had been circulated, were passed without comments.

(b) A report by Messrs. G. Martin and L. E. Elliott upon "The Cause of Variability in the Plasticity of Plantation Rubber After Storage" copies of which had been circulated, was noted.

(c)) "A Report on Diseases and Pests of Rubber, 1930," prepared by Mr. Murray for the Kalutara Planters' Association, was tabled.

7. TESTS OF PROPRIETARY PRODUCTS

A memorandum submitted by the Chief Technical Officer, together with a certain draft procedure was read. The Chairman suggested that any hard-and-fast rule would not be advisable, that, as a general policy, the Scheme should refuse to carry out tests, but that each application might be considered on its own merits. It was decided that in the case of any costly article reference should be made to the Board, tests of small articles being left to the discretion of the Chairman or the Chief Technical Officer. Under no circumstance should manufacturers be permitted to use any report of the Scheme for the purpose of advertisement; no report on any proprietary article or machine should be made by the staff without the sanction of the Board.

8. LAWYERS OF THE SCHEME

(a) Mr. Dias proposed that Messrs. F. J. and G. de Saram be appointed lawyers of the Board. Mr. Senanayake seconded.—Carried.

(b) *Seal and Crest.*—The Board desired that the design of the Ceylon crest be adopted, with an elephant and a rubber tree; a fresh drawing to be submitted at the next meeting.

9. PUBLICATIONS

(a) A letter from the Secretary of the London Advisory Committee asking that 57 copies of the Scheme's publications should continue to be supplied for circulation to members of the Committee, to technical journals, and to Government departments and other organisations in London with whom arrangements for the exchange of publications are in force, was noted. The Chairman reported that the Rubber Growers' Association had yet to state their requirements, but that their bulletins would be circulated through the Secretary only to the members of the Board. Consideration of a Scheme of local circulation of the Scheme's publications was deferred.

(b) A letter from the Malayan Fertilisers Ltd., asking for permission to reprint Mr. Taylor's booklet "Replanting and Rejuvenation of old Rubber" was left to be dealt with at the discretion of the Chairman.

(c) A reprint of Mr. Lord's report on a visit to Malaya, Indo-China, Sumatra and Java, which had appeared in *The Tropical Agriculturist* for October 1929, at a cost of Rs. 125 for 750 copies, was sanctioned.

By order,
J. I. GNANAMUTTU,
Secretary,
Board of Management.

RUBBER RESEARCH SCHEME (CEYLON)

EXTRAORDINARY GENERAL MEETING

AN Extraordinary General Meeting of the members of the Rubber Research Scheme (Ceylon), subscribers to its funds up to July 31, 1930, was held in the ball-room of the Grand Oriental Hotel, Colombo, at 11 a.m. on Thursday, March 26, 1931.

Present :—The Hon. Dr. W. Youngman, (in the chair), Messrs. C. W. Bickmore, Assistant Colonial Treasurer, C. L. Carson-Parker, representing Messrs. Bois Bros. & Co., J. A. D. Finch Noyes, representing Messrs. George Steuart & Co., F. F. Roe, representing Messrs. Gordon Frazer & Co., Ltd., Mr. J. S. McIntyre, representing Messrs. Leechman & Co., Mr. G. R. Whitby, representing Messrs. Bosanquet & Skrine, Ltd., Mr. Wilmot A. Perera, representing the Hegalla Tea & Rubber Estates Ltd., Mr. H. R. Freeman and Mr. A. E. de Silva, members of the present Board of Management, Mr. T. E. H. O'Brien, Chemist & Chief Technical Officer, and Mr. R. K. S. Murray, Mycologist, Mr. J. I. Gnanamuttu (Secretary).

In opening the proceedings, the Chairman drew the attention of the meeting to the accounts. There was a balance sheet and an income and expenditure account as at July 31, and a further set of accounts as at December 31. The former up to the date the new Board of Management was constituted under Ordinance No. 10 of 1930 and had been audited by Messrs. Duncum, Watkins, Ford & Co. The latter had been audited and certified by the Colonial Auditor. In the period August to December, the Board of Management had been carrying on the old Rubber Research Scheme from the balance of its funds which were now exhausted. These accounts complete the transactions of the whole of 1930. The Chairman asked the sanction of the meeting to pay Messrs. Duncum, Watkins, Ford & Co. the fee of Rs. 500 which had been voted for 1930. This payment was passed unanimously. The accounts as published were accepted.

The Chairman stated that following the main report of the Scheme for 1930, were the reports of the technical officers of the Scheme. Messrs. O'Brien and Murray would supply any information that might be desired in relation to those reports. The reports of the Chemist, the Physiological Botanist, and the Mycologist were accepted without comments.

The report of the London Advisory Committee was then passed without comments.

The Chairman then submitted that at the final meeting of the Executive Committee of the erstwhile Rubber Research Scheme, which was held on October 24, 1930, it had been unanimously resolved :

> "That the entire assets, liabilities and staff of the old Rubber Research Scheme be offered to the Board of Management of the new Rubber Research Scheme, with effect from August 1, 1930, the date on which the Rubber Research Ordinance came into operation."

He moved that the meeting should confirm this decision on behalf of the subscribers. The resolution was assented to unanimously.

The Chairman then moved that the meeting should record the assent of the subscribers to the assignment of the lease of the land at Nivitigalakele entered into by the Crown with the erstwhile Rubber Research Scheme (Ceylon), to the Board of Management of the Rubber Research Scheme as constituted under Ordinance No. 10 of 1930. This was carried unanimously. The transference of the leases of land held at Culloden from the Rosehaugh (Ceylon) Rubber Co. Ltd., to the Board of Management of the new Scheme was also unanimously agreed to.

The Chairman concluded by stating that was all the business he had to put before the meeting which marked the passing of the old Rubber Research Scheme and the institution of the new Scheme constituted under Ordinance No. 10 of 1930. A résumé of the publications issued by the staff under the old Scheme was attached to the report, and it shewed that some 41 Quarterly and Special Circulars and 50 Bulletins had been issued. He had no doubt but that those publications had been of some use, and he hoped that the activities of the new Board would be of further use and do something to help, if possible, to put the rubber industry of Ceylon on its feet again.

The Chairman invited remarks from those present. Mr. Roe asked a question about the continuation of the research work in London. The Chairman replied that the new Board of Management had resolved to continue the London organization in 1931 and had under consideration a proposal to amalgamate the work in London for both Ceylon and Malaya.

J. I. GNANAMUTTU,
Secretary,
Board of Management,
Rubber Research Scheme.

TEA RESEARCH INSTITUTE

MINUTES OF LAST BOARD MEETING

HELP FOR SMALL-HOLDERS ESSENTIAL
SUB-COMMITTEE APPOINTED

A meeting of the Board of the Tea Research Institute of Ceylon, was held in the Victoria Commemoration Buildings, Kandy, in April.

Those present were: Mr. R. G. Coombe (Chariman), the Colonial Treasurer, the Director of Agriculture, Messrs. A. G. Baynham. J. W. Oldfield, John Horsfall, Jas. Forbes (Jnr.), R. R. Muras (Assistant Secretary), A. W. L. Turner (Secretary), and by invitation Dr. Roland V. Norris (Director, T.R.I.).

The Chairman announced that Mr. G. K. Stewart had been elected Chairman of the Ceylon Estates Proprietary Association, and automatically succeeded Mr. F. F. Roe on the Board.

He proposed that a cordial vote of appreciation be passed to Mr. F. F. Roe for his services on the Board. This was carried.

FINANCE

Second Conference of the T.R.I.—An additional vote of Rs. 500 was sanctioned to cover the expenditure incurred in connexion with the Conference of the T.R.I. held at St. Coombs in February last.

Finance Sub-Committee.—The Chairman remarked that this Sub-Committee had met that morning and all the members of the Board would receive minutes of that meeting in due course.

Bungalows.—The Chairman said that the last building programme which was drawn up allowed for one senior staff bungalow in 1932 and one in 1933. Certain difficulties had arisen in connection with the housing of the senior staff.

It was decided that should funds permit the programme should be advanced in six months.

ST. COOMBS ESTATE

Visiting Agent.—The Chairman announced that Mr. J. W. Ferguson had returned from leave and relieved Mr. J. E. B. Baillie-Hamilton, who was acting for him as Visiting Agent of St. Coombs.

Mr. John Horsfall proposed that a vote of thanks be recorded to the Acting Visiting Agent, Mr. Baillie-Hamilton. This was carried.

SECOND CONFERENCE OF THE T.R.I.

The Chairman announced that the Second Conference of the T.R.I. was held on the 26th and 27th February, the laboratories being opened by His Excellency the Officer Administering the Government. A full report would be published in *The Tea Quarterly.*

Major Oldfield proposed that a vote of thanks to Dr. Norris be recorded for the extremely able way in which the Conference was conducted. This was agreed to.

The Chairman said that he would like to associate himself with Major Oldfield's remarks.

THE PERSIAN TEA INSTITUTE

The consideration of an application of a request by the Persian Tea Institute for one of its representatives to be instructed in all branches of tea planted was postponed pending settlement of an outstanding account for tea seed purchased in October, 1929.

SMALL-HOLDERS

The Chairman said that Mr. Panabokke was not able to be present that day and had asked that his resolution be postponed.

The Chairman added that his was not a new question and he thought that they should appoint a small Sub-Committee. It was very essential that they should do something to help the small-holders. He therefore proposed that a Sub-Committee be appointed to go into the ways and means to help the small-holders and that they should ask Mr. Panabokke to propose his resolution at the next meeting.

The Board decided to appoint the following Sub-Committee:—

Messrs. D. S. Senanayake, T. B. Panabokke, the Director, T.R.I., and the Director of Agriculture.

PESTS AND DISEASES

Termites.—The Chairman stated that a circular, dated the 17th March, in connexion with Dr. Snyder's visit to Ceylon as well as the views of the various members of the Board thereon had been sent to each member of the Board.

It was decided that the Board write to Government and inform them that the Institute would be prepared to pay some proportion of the expenses.

EXPERIMENTAL AND ESTATE SUB-COMMITTEE

The Chairman's action in having invited Mr. Jas. Forbes (Jnr.) to fill the vacancy created by the resignation of Mr. Huntley-Wilkinson as from the 1st March, 1931, was confirmed by the Board.

The Chairman said that this Sub-Committee had held a meeting at St. Coombs the previous day in connexion with pruning. Another meeting had been held that morning at the Experimental Station, Peradeniya, and it had been tentatively suggested that certain experiments in pruning should be carried out simultaneously at St. Coombs and Peradeniya. He considered that those interested should know that these experiments were to be carried out and that they could come and see them. In the course of time they hoped to shew villagers how pruning should be carried out. He suggested that the Director should be asked to make a statement at a General Committee Meeting of the P. A. and also address the next Estate Products meeting on the subject.

PUBLICATIONS

The Director stated that a suggestion arose in regard to the publication of experimental result. At present the Institute's publications consisted of Bulletins and *The Tea Quarterly* and he thought that work which was in progress should be published in *The Tea Quarterly* and the Bulletins utilised for the publication of completed pieces of work. In the above publications the papers would not be in their technical form and officers naturally wished to publish their full technical results, but it would be agreed that if these were published in a very technical way in the Institute's publications and circulated to all planters and subscribers no very useful purpose would be served. He therefore thought that the best solution was that officers should be allowed to contribute to outside journals, but, of course, all such results would first be published in a popular form in the Institute's publications.

The Board agreed to these proposals.

Factory Handbook.—The Director mentioned that they had received a considerable number of enquiries about the Handbook of Factory Information. It required amplification and for that reason it had not yet been published in Bulletin form. It was his intention to amplify the book and publish it later—probably by the end of the year, when it would be sent to all subscribers to *The Tea Quarterly*.

The Board agreed to this course.

DEPARTMENTAL NOTES

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA

FOR THE MONTHS OF MARCH AND APRIL, 1931

TEA

THE decision to cease experimentation in tea has been provisionally reversed, and the duplication of a pruning experiment, or part of experiment, to be carried out by the Tea Research Institute at St. Coombs is now under discussion.

The tea in general suffered more severely from the drought that has been observed for a number of years. Though exact comparison is not possible owing to differentiation of treatment, it may be stated that the tea which survived the drought best was that under *Albizzia* or *Gliricidia* with or without a cover crop, next tea under dadaps with *Indigofera endecaphylla*, next tea with *Indigofera* but no shade trees, next tea under dadaps but no cover crop, and lastly tea with no shade trees and no cover crop.

Supplies suffered severely and 46% of the plants put in 1930 were lost. Tentative conclusions as to the survival of supplies under different conditions drawn in the progress report for July and August, 1930, cannot be maintained

The usual manures were applied to the plots under the *Indigofera* trial in the usual manner in April. This will be the last application of these manures, as this trial, in its present form, is due to terminate at the end of September, 1931. Future manurial treatment will depend partly on the plans for a pruning experiment. All plots not included in the *Indigofera* trial were forked in alternate rows in the latter half of April. Alternate shade trees were lopped before this forking and all loppings were forked in. In plots where *Indigofera endecaphylla* was growing, as much of the creeper as possible was forked in, but without cutting the creeper it was found difficult to incorporate much of the green material. Two furrow forks supplied by Messrs. Harrisons and Crosfield were tried during these forking operations. These forks, which are fitted with a flat strip of metal across the prongs, certainly tend to prevent earth passing through the prongs during the pushing forward motion of envelope-forking and thus leave a clearer open "envelope" for the insertion of green material, etc.

RUBBER

The Hilltop Rubber

The experiments in this area terminated at the end of December, 1930. The final results are given below.

The Hilltop Rubber (which was planted in 1913) is divided into three blocks, A, B, and C.

Block A is planted with clumps of 4 trees 12 feet by 15 feet, with 40 feet between the clumps, giving 69 trees per acre.

Block B is planted in avenues 12 feet by 15 feet, with 40 feet between the avenues, giving 112 trees per acre.

Block C is planted 20 feet by 20 feet, giving 109 trees per acre.

Half the trees in blocks A and B are tapped with a V cut and half with a single cut, while in block C half the trees are tapped on alternate days and half every third day. To compare the three methods of planting, therefore, it is only possible to take into consideration those trees which are tapped on alternate days with a single cut, i. e., half the number of trees in each block. Tapping was started on April 1st, 1922, but thereafter yields were recorded from January to December so that the first period is one of nine months only. The yields are given in the following table:

Block and method of planting	No. of trees per acre	Average yield per tree			Calculated yield per acre		
		1930	Previous	Total	1930	Previous	Total
		lb. oz.	lb. oz.	lb. oz.	lb.	lb.	lb.
A Clumps of 4 trees 12 ft. by 15 ft. with 40 ft. between clumps	69	7 5	33 1	40 6	505	2430	2935
B Avenues. Trees 12 ft. by 15 ft. with 40 ft. between avenues	112	3 6	21 7	24 13	378	2377	2755
C Square planting 20 ft. by 20 ft.	109	4 3	25 3	29 6	456	2731	3187

The relative positions of the blocks as regards yield per tree has been the same throughout the experiment. The superiority of yield per tree in block A has progressively increased until in 1926 the calculated yield per acre of the block was within 1 lb. of that of block B which has 112 trees per acre. In 1927 and succeeding years the yield per acre in block A has exceeded that in block B but has never reached that of block C.

In growth, as shown by girth measurements, block A has shown the same superiority.

	Average girth December 1921 Inches	Average girth December 1930 Inches	Average increase Inches
Block A ...	28·5	54·8	26·3
Block B ...	29.5	43·9	14·4
Block C ...	27·5	43·0	15·5

The superiority in the development of side branches and in foliage of the trees in block A on the outside of the clumps is very marked. One side of this block adjoins a tea field and thus has the advantage of further additional light and air. On the other hand this side is also very exposed to wind and one would have expected this to have a detrimental effect on early growth.

The superiority of outside trees in branch development, foliage and yield is a matter of common observation and in the case of block A it would certainly appear that by giving two sides of each tree a clear space the yield per tree had been increased to such an extent as finally to more than compensate for the reduced number of trees per acre. Such a method of planting in widely spaced clumps would have the further advantage that the cultivation of a catch crop would be facilitated and could be continued considerably later than with ordinary planting. Alternatively, on flat land, cultivation by implements could be continued later. On the other hand there is the grave disadvantage that if a case of root disease occurs it is most probable that all four trees of the clump would be affected since their roots are intermingled and isolation is difficult or impossible.

The reason for the comparative inferiority of block B is hard to find. The trees are growing on almost flat land well sheltered on every side. Block C, on the other land, is steep and rocky but the trees have always yielded better than those of block B. One is rather led to infer from the yields of these blocks that light and air are more important factors than protection from wind.

As has been mentioned half the trees in blocks A and B were tapped with a V-cut and half with a single left-to-right cut. In both cases the cuts occupy half the circumference and are at the same height from the ground. The average yields per tree from the start of the experiment are given below :

Year	Single cut			V cut			Average increase per tree from use of V cut
	Block A	Block B	Average	Block A	Block B	Average	
	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
1922	2 7	1 12	2 1	2 5	1 12	2 0	− 1
1923	3 11	2 4	3 0	4 0	2 12	3 6	+ 6
1924	4 14	2 13	3 13	5 10	3 7	4 9	+ 12
1925	5 0	3 2	4 1	5 7	3 10	4 9	+ 8
1926	4 8	3 0	3 12	5 3	3 0	4 1	+ 5
1927	5 0	2 14	3 15	5 6	3 9	4 8	+ 9
1928	4 7	2 10	3 8	4 15	3 6	4 2	+ 10
1929	5 11	3 0	4 6	6 11	4 3	5 7	+1 1
1930	7 5	3 6	5 6	7 15	5 2	6 8	+1 2
Total	42 15	24 13	33 13	47 8	30 13	39 2	+5 5

After the first period there has been a substantial, and apparently increasing, gain in favour of the V cut, amounting, over the whole period, to 5 lb. 5 oz. per tree.

One of the advantages claimed for the V cut is a reduction in the proportion of scrap to total crop. The percentage of scrap obtained by these two methods of tapping is shown below :

Year	Percentage scrap of total crop	
	Single cut	V cut
1922	11·0	11·6
1923	10·7	13·9
1924	16·8	14·4
1925	17·7	10·0
1926	23·3	19·0
1927	17·1	17·9
1928	18·0	20·5
1929	21·4	15·8
1930	19·1	14·5
Average	17·2	15·3

Over the whole period there is a slight gain in favour of the V cut but this has not been consistent and is possibly fortuitous.

In block C a comparison between alternate day tapping and three-day tapping has been in progress. The cuts on the trees tapped every three days were started at two-thirds the height of the cuts on the trees tapped on alternate days so that the two cuts have reached the bottom of the trees at the same time. The following table shows the average yields per tree :

	Alternate day tapping				Three-day tapping				Percentage of alternate day tapping yields obtained by three day tapping
	Series 1	Series 3	Series 5	Average	Series 2	Series 4	Series 6	Average	
Year	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	%
*1922	2 2	2 3	1 13	2 1	1 10	1 9	1 9	1 9	75·5
1923	3 0	3 2	2 10	2 15	2 10	2 4	2 8	2 7	85·1
1924	3 6	4 1	3 5	3 9	2 12	2 13	2 13	2 13	79·0
1925	3 6	3 12	3 13	3 11	2 15	2 15	2 15	2 15	81·4
1926	3 3	3 4	3 1	3 3	2 14	2 12	2 11	2 12	80·9
1927	3 5	2 15	3 8	3 4	2 6	2 8	2 7	2 7	82·5
1928	3 1	3 0	2 13	2 15	2 2	1 15	2 2	2 1	74·6
1929	3 11	3 14	3 11	3 12	3 5	2 13	2 11	2 15	78·3
1930	4 12	4 0	4 0	4 4	3 13	3 4	3 0	3 6	79·4
Total	29 14	30 3	28 10	29 10	24 7	22 13	22 12	23 5	79·6

* April to December only.

It would appear that a reduction of the number of tappings by one-third has only reduced the yield by about one-fifth. The cost of production would not of course be reduced by one-third but it appears probable that the cost of production of the rubber obtained from the trees tapped every third day would be less than the cost of the rubber obtained by alternate day tapping.

A possibly more potent argument in favour of three-day tapping is the undoubted reduction in brown bast incidence. At the end of 1930, out of 168 trees tapped by each method, 45 or 26.8%, had been treated for brown bast or showed symptoms of the disease among the trees tapped on alternate days against 12 trees, or 7.1%, of the trees tapped every three days. This difference has been consistently shown throughout the experiment and confirms a similar result found in a previous two-versus-three-day tapping experiment. A considerable number of fresh brown bast cases were noted in 1930.

The Hillside Rubber

In this area an experiment has been carried on since April 1st, 1922 to compare the yields and disease incidence from tapping on alternate days throughout the year and tapping daily in alternate months. To obviate differences caused by unequal weather conditions in the different months, two series were tapped daily in the months of January, March, May, etc., two in the months of February, April, June, etc., while the remaining two series were tapped throughout the year on alternate days.

The average yields per tree from the start of the experiment are given below.

	Alternate daily throughout the year			Daily in January, March, May, etc.			Daily in February, April, June, etc.			
	Series 1	Series 6	Average	Series 2	Series 4	Average	Series 3	Series 5	Average	Average of all daily tapped blocks
Year	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
*1922	1 14	1 14	1 14	1 13	2 0	1 14	1 15	1 15	1 15	1 15
1923	3 8	3 0	3 4	3 0	3 3	3 2	2 14	3 0	2 15	3 0
1924	4 1	3 11	3 14	3 9	3 8	3 8	3 14	3 14	3 14	3 11
1925	3 13	3 4	3 9	3 10	3 9	3 9	3 12	3 15	3 14	3 11
1926	3 10	3 5	3 8	3 11	3 9	3 10	4 5	3 8	3 15	3 13
1927	4 4	4 12	4 8	3 5	3 12	3 8	3 14	4 0	3 15	3 12
1928	4 2	4 2	4 2	2 15	3 6	3 3	3 4	3 9	3 6	3 4
1929	4 10	4 7	4 8	3 12	4 8	4 3	4 3	4 6	4 4	4 4
1930	5 10	5 7	5 8	4 5	5 5	4 13	5 10	5 2	5 6	5 2
Total	35 8	33 14	34 11	30 0	32 12	31 6	33 11	33 5	33 8	32 8

* April to December only.

Over the whole period of 8 years and 9 months the average yield per tree shows a superiority of 2 lb. 3 oz. in the plots tapped on alternate days. It is found that after resting for a month, the trees which are tapped daily in alternate months usually take seven to ten days before attaining their maximum flow of latex and in view of this it is perhaps surprising that the yields of the daily tapped series come as close to the yields of the series tapped on alternate days as they do. From the results of this experiment one would say that there appears to be no advantage as regards yield to be gained by adopting monthly periodic tapping in place of the customary alternate day tapping, though it might be considered more convenient to have all the tapping labour concentrated in one portion of the estate during any one month.

In the matter of brown bast incidence there appears to be a decided disadvantage in tapping daily in alternate months. At the end of 1930, 22·9% of the trees tapped daily in alternate months had been treated for or showed symptoms of brown bast against 10·9% of those tapped on alternate days. Although the difference in brown bast incidence between alternate day tapping and tapping daily in alternate months has never been as striking as between alternate day tapping and three-day tapping, yet throughout the course of the experiment the trees tapped daily in alternate months have always shown a considerably higher incidence, and for this reason, if for no other, it does not appear possible to recommend the system.

The Change-over Experiment

In the last report bark renewal figures for this experiment were given, and at the last meeting of the Estate Products Committee a question was asked as to the incidence of brown bast in this experiment. These figures are given below, but it would be difficult to draw from them any definite conclusion as to the effect of changing over the cut on the incidence of brown bast.

Incidence of Brown Bast in Change-over Experiment at end of 1930

No change-over		Change-over once yearly		Change-over twice yearly	
Plot	No. of cases	Plot	No. of cases	Plot	No. of cases
(1)	1	(1)	2	(1)	nil
(2)	nil	(2)	1	(2)	nil
(3)	1	(3)	3	(3)	nil
(4)	nil	(4)	nil	(4)	1
(5)	1	(5)	1	(5)	3
(6)	2	(6)	4	(6)	nil
(7)	nil	(7)	1	(7)	3
(8)	nil	(8)	1	(8)	1
	5 = 3·9%		13 = 10%		8 = 6·2%

CACAO

The pruning programme outlined in the January-February report has made fair progress. All the ordinary pruning has been completed and about half the Hillside Block, where a gradual removal of the old stems and rejuvenation from suckers is in progress, has been dealt with. This is very heavy and slow work and can only be done with a cross cut saw. The cutting up of the felled stems has not yet been attempted. No labour has yet been available to start the pollarding in the centre block.

The manurial experiment was brought to a conclusion at the end of March, and the results were incorporated in an article submitted in April for publication in *The Tropical Agriculturist.*

The yields of dry cacao per acre for the last 8 years have been as follows:

Year	Cwt. dry cacao per acre	Rainfall
1923-24	2·24	106·42
1924-25	3·10	103·82
1925-26	5·45	87·31
1926-27	5·03	98·11
1927-28	4·41	80·33
1928-29	2·49	88·95
1929-30	4·58	98·71
1930-31	3·15	89·75

The percentages of good and black cacao during the last four years have been as follows:

Year	Good	Black	Rainfall
1927-28	82·9	17·1	80·33
1928-29	73·4	26·6	88·95
1929-30	83·2	16·8	98·71
1930-31	69·5	30·5	89·75

The percentage of black cacao is more influenced by the seasonal incidence of the rainfall than by the total fall. Very heavy rain fell in October and November 1930—19·02 and 10·98 inches respectively.

COFFEE

Half the shade trees (*Gliricidia maculata*) were uprooted in plots 140 N, 140 J, and 140 K. Further thinning of coffee shade is required in the six-acre coffee field and elsewhere, and this will be done as soon as labour can be spared.

The last of the Hybrid coffee bushes in plot 140 H (round the show plots) were uprooted during April.

Recent prices for coffee have been exceedingly low. Two auction sales were abandoned owing to lack of bidders and coffee sent to Colombo for sale fetched the equivalent of the following prices per pound:

Robusta	varieties,	parchment	12	cts.	per lb.
,,	,,	sundried	$3\frac{1}{2}$	,,	,,
Liberian	,,	,,	$1\frac{3}{4}$	,,	,,

FODDER PLANTS

A further area of the Panchikawatte paddy fields was drained and planted in April with Guinea grass. About half this area is now planted in different fodder grasses.

GREEN MANURES AND COVER PLANTS

The *Centrosema pubescens* in the young budded rubber in plot 174 had got badly overgrown with couch, illuk, sensitive plant, and other weed growth. The whole cover was uprooted in March and strips were ploughed between the young trees and *Centrosema* sown again in April.

The green manure experiments which have been carried on in collaboration with the Agricultural Chemist in plots 16-20 and in the Annual Economic Area were brought to a conclusion with the taking of the last annual soil samples in April. Results will be published in due course by the Agricultural Chemist.

OIL YIELDING PLANTS

In the terraced valley an additional 33 plants of *Taraktogenos kurzii* (Chaulmoogra oil), and an additional 56 plants of *Aleurites montana* (tung oil) were planted out in April. Further plants of *Aleurites montana* are coming on in pots and a further area is being terraced and prepared for their reception.

During March a great deal of Croton oil seed was shed from the trees in the economic collection. Nearly all this seed was empty and useless. An examination of the seed by the Mycologist and by the Entomologist revealed no disease or pest, and the trouble must be presumed to be physiological and probably due to drought conditions.

An enquiry addressed to the Imperial Institute as to whether any new uses have been found for Croton oil produced the reply given below :

Imperial Institute,
South Kensington,
London, S. W. 7.
April 1, 1931.

Ref. No. 681/2.

Sir,

" In reply to your letter (A. 2615) of the 23rd February, I have to send you the following information :

" Croton Tiglium oil is principally used in medicine, as a very powerful purgative. It appears to be customary for firms in this country to prepare the oil themselves from imported seed. Very little, if any, croton oil is

imported here. There is a more or less regular demand for the seed in the United Kingdom. Latterly there has been a severe shortage, and for the past six months the value of the seed in London has been between about 230s. and 290s. per cwt., that of the oil being about 14s. to 15s. per lb. The 'normal' values of the seed and of the oil are about 30s. to 40s. per cwt and 3s. 9d. per lb. respectively.

"Recent quotations were 280s. per cwt. for the seed, and 13s. 4½d. per lb. for the oil, and according to firms that have been consulted by the Imperial Institute there are indications that conditions in the market are becoming easier."

THE IRIYAGAMA DIVISION

The clearing of a new area to contain three more foreign clones, with H2 as control, is in progress.

It will not be possible to import stumps of any more promising foreign clones for the present owing to lack of funds. The original estimates contained no provision for such importations.

Below area 2, 312 1928 seedling trees which are not included in any area remain standing. These trees are being utilised as follows: 42 trees for a small experiment to be known as the influence of scion on seedling stock experiment. These trees have been divided into two groups, in randomised pairs. One group is to be budded with B.D 5 at 3 feet from the ground; the other group will not be budded. The idea is to tap both groups above 3 feet and below three feet and note any effect produced on the yields of the stock by the addition of a scion of a proved high-yielding clone.

The remainder of the trees are to be used for an experiment to be called influence of scion on budded stock experiment. All these trees have been budded low down with AVROS 49 and when these bud shoots are sufficiently large and mature, half the trees will be budded high up with buds from a proved high-yielding clone and half with buds from a known low-yielding tree. The trees will then be tapped to determine whether the trees bearing crowns of a high-yielding clone yield better than those bearing crowns of a low-yielding clone. The experiment is considered to be likely to yield more valuable results than the influence of scion on seedling stock experiment, since in that experiment the yields of the seedling stocks (although they are all grown from seed of one tree) are likely to show more variation than the yields of the budded stocks in the influence of scion on budded stock experiment.

GENERAL

With the advent of the rains the shortage of labour resulting from reduced funds, aided by the annual dislocation caused by the Sinhalese New Year, has been severely felt. It has not yet been possible to start the annual cleaning of drains, and women and children have had to be put on for the very urgent work of eradicating couch and illuk. The work of course has not been so efficiently performed and is not likely to prove very satisfactory.

T. H. HOLLAND,
Manager,
Experiment Station, Peradeniya.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st MAY, 1931

Province, &c.	Disease	No. of Cases up to Date since Jan. 1st 1931	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	328	88	54	239	19	16
	Foot-and-mouth disease	665	195	615	15	35	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	2 *	...	...	...	...	2
	Piroplasmosis	...	...	...	...	...	...
Colombo Municipality	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	215	4	199	8	8	...
	Anthrax (Sheep & Goats)	11 †	..	...	11	...	...
	Rabies (Dogs)	3	1	...	...	...	3
	Haemorrhagic Septicaemia	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Bovine Tuberculosis	...	...	...	...	...	...
Cattle Quarantine Station	Rinderpest	.	...	...	...	...	...
	Foot-and-mouth disease	28	28	...	...	28	...
	Anthrax (Sheep & Goats)	97	9	...	97	...	...
Central	Rinderpest	...	..	..	..	...	...
	Foot-and-mouth disease	149	135	50	...	89	...
	Anthrax	...	...	..	...	...	..
	Rabies (Dogs)	7	1	...	..	...	7
Southern	Rinderpest	...	..	...	...	...	...
	Foot-and-mouth disease	1346	307	1216	5	125	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	...	..	...	...	...
Northern	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
	Black Quarter						
	Rabies (Dogs)						
Eastern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	...	...		...	...
	Anthrax	...	...	...	...	...	...
	Surra	5	...	...	5	...	.
North-Western	Rinderpest	8972	2435	100	8042	55	775
	Foot-and-mouth disease	44	44	...	...	44	...
	Anthrax	...	...	...	.	...	...
	Pleuro-Pneumonia (in Goats)	...	...	...	...	...	...
North-Central	Rinderpest	3335	914	449	2677	114	95
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	5	4	1	...	4	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	.	...	...	...	...
Sabaragamuwa	Rinderpest	...	...	..	...	...	...
	Foot-and-mouth disease	68	27	45	...	23	...
	Anthrax	..	...	...	...	...	...
	Haemorrhagic Septicaemia	24	6	...	24	...	...
	Piroplasmosis	2	1	1	...	1	...
	Rabies (Dogs)	3	2	...	...	...	3

* 1 case in a cow. † 2 cases amongst cattle.

G. V. S. Office,
Colombo, 10th June, 1931.

G. W. STURGESS,
Government Veterinary Surgeon.

METEOROLOGICAL REPORT

MAY, 1931

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Inches		Inches
Colombo -	87·3	+ 0·3	77·2	+ 0·3	79	91	8·4	11·81	27	− 2·39
Puttalam -	89·0	+ 1·2	78·6	+ 1·0	75	87	6·6	1·33	12	- 2·30
Mannar -	90·4	− 0·1	81·3	+ 1·1	74	81	4·5	0·84	2	− 1·27
Jaffna -	88·2	+ 0·6	82·8	+ 1·3	77	79	4·6	1·38	2	− 0·44
Trincomalee -	91·3	− 0·8	78·3	+ 0·3	—	—	—	3·18	6	+ 0·47
Batticaloa -	89·5	− 0·7	77·3	+ 0·8	76	93	6·8	1·48	6	− 0·37
Hambantota -	87·8	+ 1·2	77·9	+ 1·9	77	89	5·4	1·87	10	− 1·45
Galle -	85·0	+ 0·1	78·1	− 0·1	85	91	7·4	12·41	22	+ 0·92
Ratnapura -	88·8	+ 0·9	75·1	0	78	93	5·6	18·47	22	+ 0·06
A'pura -	90·3	−0·3	76·2	+ 0·1	71	88	8·4	5·05	7	+ 1·62
Kurunegala -	89·3	0·3	76·2	+ 0·5	72	88	7·6	5·65	12	− 1·09
Kandy -	87·1	+ 1·6	70·9	+ 0·1	72	90	6·6	3·37	14	− 2·45
Badulla -	85·7	+ 0·4	66·8	+ 1·2	73	95	5·3	3·14	10	− 1·59
Diyatalawa -	80·6	+ 2·6	63·1	+ 1·5	67	84	6·0	3·13	8	− 2·25
Hakgala -	75·2	+ 1·7	58·8	+ 1·9	72	89	5·1	2·23	13	− 5·00
N'Eliya -	72·0	+ 1·3	53·3	+ 1·6	76	94	7·2	4·16	13	− 2·86

The rainfall of May was distinctly below average, deficits being most marked in the upper part of the Kelani Valley and the Ambegamuwa and Pussellawa districts. The chief areas in which the average was passed were the western half of the S.P., and a few stations in central Sabaragamuwa and the northern part of the W.P. Averages were also exceeded at most of the stations in the N.C.P. and at a few in each of the N.P., N.W.P., and E.P., though in these cases the excess did not depend so much on very heavy rain as on the lowness of the averages for May.

In the first half of the month such rain as occurred was largely of the thunderstorm type. There were several noteworthy falls on the 3rd, chiefly near the west coast, including Angoda 9·69 and Horakelle 7·72, and also on the 7th when Eheliyagoda reported 9·05, and 9th including Kokkawita 7·45. Squally weather was also noteworthy in the Batticaloa district on the 10th and 11th. From the 15th to the 22nd there was comparatively little rain but from the 23rd to the end of the month there was pretty general rain over the south-west quarter, but comparatively few very heavy falls, though Mawarella and Morawake each recorded about 7 inches on the 25th.

The highest totals were at Carney 29·09 (which is however below the average at the station) and Eheliyagoda 28·60.

The total wind movement was above average in the north, and below it in the south. On the west coast there was less monsoonal activity than usual during the greater part of the month but some vigorous squalls from the 26th onwards, including a velocity of over 50 miles per hour at the Pilot Station on the 29th.

The duration of sunshine was a trifle below normal, although it will be seen that temperatures were on the whole slightly above average.

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